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**16 Mar 1981, ST-A per CSL D/A ltr; 16 Mar
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REPORT NO. DPS TB4-005, 1

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AUTOMOTIVE DIVISION

REPORT ON

BALLISTIC EVALUATION OF ALUMINUM ARMOR (U)

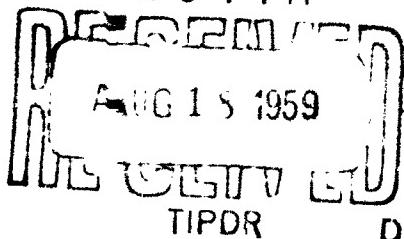
First Report On Ordnance Project No. TB4-005

(AD-1274)

T. J. GRIFFIN

AUGUST 1959

ASTIA



*Aberdeen Proving Ground
Maryland*

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DEVELOPMENT AND PROOF SERVICES
ABERDEEN PROVING GROUND
MARYLAND

AUTHORITY: ORDBA-1320
PRIORITY : 1A

TJUr if: 14/v1/32175

BALLISTIC EVALUATION OF ALUMINUM ALLOY ARMOR

First Report on Ordnance Project No. TB4-005

(AD-1274)

Dates of Test: March to June 1959

ABSTRACT (U)

Thirteen aluminum alloy armor plates varying in thickness from 1/2 to 1-3/4 inches were furnished by Frankford Arsenal for ballistic evaluation. Protection ballistic limits were obtained for a number of obliquity - thickness conditions with caliber .30 AP, ball, and fragment-simulating projectiles, and caliber .50 AP and ball projectiles.

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1. (U) INTRODUCTION

Aluminum armor is not new to Ordnance. Specifications for aluminum of the 2024 type have been in existence for approximately fifteen years. These specifications are for plate of minimum weight whose purpose is to defeat and protect against shell fragments and small-arms projectiles. Unfortunately the 2024 type aluminum does not lend itself to the construction of vehicles because of the welding difficulties encountered when conventional techniques are used. Therefore weldable types of aluminum (5083) which offer good protection against fragments have been selected for the M113 full-tracked personnel carrier. This selection of aluminum over steel armor was to obtain air-transportability for this vehicle.

Ballistic tests have been conducted at several arsenals and at this Proving Ground on aluminum alloy armor which is high in magnesium content. These alloys have been primarily types 5083 and 5456. To supplement existing data Frankford Arsenal requested that ballistic limits be obtained on several thicknesses of type 5083 aluminum armor at four obliquities with several projectiles. The ballistic tests conducted on these plates are the subject of this report.

2. (U) DESCRIPTION OF MATERIAL

2.1 Material

The thirteen aluminum alloy armor plates, type 5083, furnished by Frankford Arsenal were identified as given in Table I.

Table I. Aluminum Alloy Armor Plates Furnished by Frankford Arsenal

<u>Lot Number</u>	<u>Nominal Thickness, inches</u>	<u>Actual Thickness Taken at APG, inches</u>	<u>Size of Plate, inches</u>
198211	1/2	0.530	30 by 30
008711	1/2	.517	18 by 36
008712	1/2	.522	18 by 36
183701	3/4	.794	30 by 30
734-881-1	3/4	.766	18 by 36
734-881-2	3/4	.768	18 by 36
J6293-1	1	1.02	30 by 30
J6293-2	1	a	30 by 30
H6289-4C	1-1/2	1.50	18 by 36
H6288-4A	1-1/2	1.50	18 by 36
H6285-2	1-1/2	a	18 by 36
734-871-2	1-3/4	1.77	18 by 36
734-871-3	1-3/4	a	18 by 36

*Plates not gaged or used in test.

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2.2 Projectiles

The projectiles used are listed below:

Projectile, Fragment-Simulating, Caliber .30, weight 44 grains.
hardness 29-31 Rc.
Projectile, Ball, M2, Caliber .30, weight 150 grains.
Projectile, Ball, M2, Caliber .50, weight 703 grains.
Projectile, AP, M2, Caliber .30, weight 164 grains.
Projectile, AP, M2, Caliber .50, weight 710 grains.

2.3 Rifles

The rifles used are listed below:

Rifle, Accuracy, Mann type, Caliber .30, No. 1402245.
Rifle, Accuracy, Mann type, Caliber .30, No. 1512536.
Rifle, Accuracy, .300 Magnum, Caliber .30, No. 44747.
Rifle, Accuracy, Mann type, Caliber .50, No. 22.

3. (CMH) DETAILS OF TEST

3.1 Procedure and Results

The aluminum plates were gaged for thickness prior to firing. Each plate was mounted in a rigid plate butt for testing at the desired angle of obliquity. Attempts were made to obtain one ballistic limit (protection) for each of the conditions listed in Table II.

Table II. Conditions for PML

Thickness of Plate, inches	Projectile	Obliquity of Fire, degrees			
1/2	Cal .30 Ball	0	30	45	60
1/2	Cal .30 AP, M2	0	30	45	60
1/2	Cal .30 F.S.	0	-	-	-
3/4	Cal .30 Ball	0	30	45	60
3/4	Cal .30 AP, M2	-	-	-	60
3/4	Cal .30 F.S.	0	-	-	-
3/4	Cal .50 Ball	a	a	a	a
3/4	Cal .50 AP, M2	-	30	-	-
1	Cal .30 Ball	0	30	45	60
1	Cal .30 AP, M2	0	30	45	60
1	Cal .50 AP, M2	-	-	-	60

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Table II cont'd

<u>Thickness of Plate, inches</u>	<u>Projectile</u>	<u>Oblliquity of Fire, degrees</u>			
1-1/2	Cal .30 Ball	0	30	-	-
1-1/2	Cal .30 AP, M2	-	30	-	-
1-1/2	Cal .50 Ball	a	a	a	a
1-1/2	Cal .50 AP, M2	-	30	-	60
1-3/4	Cal .30 Ball	0	-	-	-
1-3/4	Cal .30 AP, M2	-	30	-	-
1-3/4	Cal .50 Ball	a	a	a	a
1-3/4	Cal .50 AP, M2	-	30	-	-

F.S. = Fragment-Simulating Projectile.

^aThese conditions were to be ballistically evaluated only if limited firings revealed a significant difference between the ballistic limits obtained with Cal .50 Ball, M2 and Cal .50 AP, M2 projectiles.

V_{50} ballistic limits (protection) were computed throughout the test by averaging the three lowest velocities resulting in complete penetration and the three highest velocities resulting in partial penetration with a velocity spread not exceeding 125 fps for all rounds used in the calculation. Where it was impossible to calculate a ballistic limit without exceeding the 125-fps spread the five lowest velocities resulting in complete penetration and the five highest velocities resulting in partial penetration were averaged to calculate the ballistic limit. No limit was placed on the velocity spread for this ten-round calculation.

The firing procedures and methods for determining partial and complete penetrations under the protection criterion followed those outlined in Ordnance Proof Manual pamphlets 50-30 and 50-10. For the different test conditions the gun-to-plate distances varied and were recorded in the round-by-round data sheets. On all firings with the fragment-simulating projectiles this distance was limited to approximately 30 feet or less to prevent yaw and tumbling of this blunt-nosed projectile.

The round-by-round tabulations of firing data may be found in Appendix C. A summary of the test results is given in Table III.

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Table III. Summary of Test Results

<u>Plate No.</u>	<u>Thickness, inches</u>	<u>Projectile</u>	<u>Oblliquity, degree</u>	<u>Ballistic Limit (Protection), fps</u>
<u>Group I (1/2-inch)</u>				
198211	0.530	Cal .30 Ball, M2	0	1564
198211	.530	Cal .30 Ball, M2	30	1903
198211	.530	Cal .30 Ball, M2	45	2173
008711	.517	Cal .30 Ball, M2	60	2715
008712	.522	Cal .30 AP, M2	0	^a 1370
008712	.522	Cal .30 AP, M2	30	1499
008712	.522	Cal .30 AP, M2	45	1731
008711	.517	Cal .30 AP, M2	60 1st	^a 2546
008712	.522	Cal .30 AP, M2	60 2nd	^a 2788
008712	.522	Cal .30 F.S.	0	2382
<u>Group II (3/4-inch)</u>				
734-881 (2)	.768	Cal .30 Ball, M2	0	1711
734-881 (2)	.768	Cal .30 Ball, M2	30	2292
734-881 (2)	.768	Cal .30 Ball, M2	45	2690
183701	.794	Cal .30 Ball, M2	60	3595 HP
734-881 (1)	.766	Cal .30 AP, M2	60	3196
183701	.794	Cal .30 F.S.	0	3493 HP
734-881 (1)	.766	Cal .50 Ball, M2	30	1301
734-881 (1)	.766	Cal .50 AP, M2	30	1367
<u>Group III (1-inch)</u>				
J6293 (1)	1.024	Cal .30 Ball, M2	0	2221
J6293 (1)	1.024	Cal .30 Ball, M2	30	2974
J6293 (1)	1.024	Cal .30 Ball, M2	45	3424
		Cal .30 Ball, M2	60	b
J6293 (1)	1.024	Cal .30 AP, M2	0	1995
J6293 (1)	1.024	Cal .30 AP, M2	30	2222
J6293 (1)	1.024	Cal .30 AP, M2	45	2754
J6293 (1)	1.024	Cal .30 AP, M2	60	^a 3468 HP
J6293 (2)	1.024	Cal .50 AP, M2	60	^a 3104 HP
<u>Group IV (1-1/2 inch)</u>				
H6289-4C	1.497	Cal .30 Ball, M2	0	3398
H6288-4A	1.497	Cal .30 Ball, M2	30	3427 HP
H6289-4C	1.497	Cal .30 AP, M2	30	2668
H6289-4C	1.497	Cal .50 Ball, M2	30	1942
H6288-4A	1.497	Cal .50 Ball, M2	60	2866 HP
H6289-4C	1.497	Cal .50 AP, M2	30	1915
H6288-4A	1.497	Cal .50 AP, M2	60	3116 HP

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Table III cont'd

<u>Plate No.</u>	<u>Thickness, inches</u>	<u>Projectile</u>	<u>Oblliquity, degree</u>	<u>Ballistic Limit (Protection), fps</u>
Group V (1-3/4 inch)				
734-871 (2)	1.767	Cal .30 Ball, M2	0	3485 HP
734-871 (2)	1.767	Cal .30 AP, M2	30	2934
734-871 (2)	1.767	Cal .50 Ball, M2	30	2103
734-871 (2)	1.767	Cal .50 AP, M2	30	1969

^aTen-round ballistic limit.^bCondition not fired - limit of gun reached on a thinner material.

HP - No ballistic limit obtained. High partial penetration (protection) shown.

Two ballistic limits were obtained on the 1/2-inch plates at 60° obliquity with the caliber .30, AP, M2 projectile. Twenty-eight rounds were fired on plate number 008711 and a ten-round limit was estimated to be 2546 fps with a 218-fps spread. Due to the large spread and number of rounds fired, a second limit was attempted on the same plate. Limited area prevented completion of another limit on plate 008711, therefore, a second plate, 008712, was used. The ballistic limit obtained on this plate was 2788 fps (ten-round) with a 217-fps spread.

An attempt was made to obtain a ballistic limit for each projectile obliquity - thickness condition, although the maximum safety level of the gun limited this objective. In several instances the limit of the gun was reached before complete penetrations were obtained. In another instance where no complete penetrations were reached at one obliquity, attempts were not made to determine a ballistic limit at a higher obliquity with the same projectile. It should also be noted that on some of the firings near the maximum limit of the gun the powder charge was not varied as required in the "up and down" method (see OPM 50-30, par. 3.3.2.e), for a ballistic limit which is statistically correct (see Appendix B). This condition could not be prevented without abandoning the test or exceeding the maximum safety level of the weapon. Since the velocities were spread over a 91-fps range without a change in propelling charge it is suspected that the error is small.

Some of the data generated from the firings contained in this report have been presented graphically in Figures 1 through 3.

The test plan described earlier included sample firings with caliber .50 ball ammunition to determine if there would be any difference between these ballistic limits and those taken with caliber .50 AP. Figure 1 indicates that the curves for each projectile follow one another very closely. This firing confirms earlier tests conducted at Frankford Arsenal. Due to the similarity shown in Figure 1 all conditions with caliber .50 ball were not fired.

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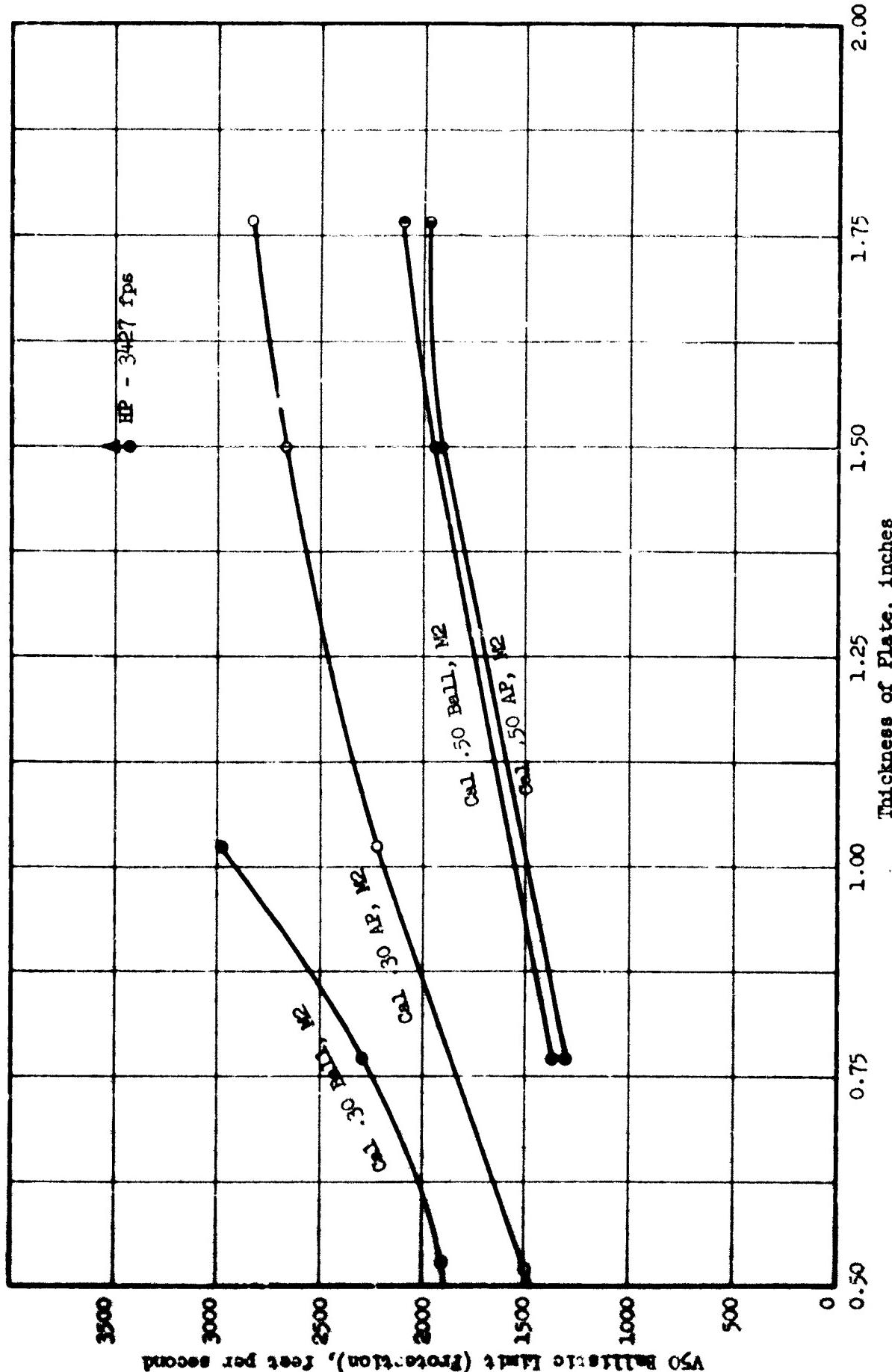


Figure 1: Comparison of Ballistic Limits Obtained on Aluminum (5083) Plate of Varying Thicknesses at 30° Obliquity.

Figure 1

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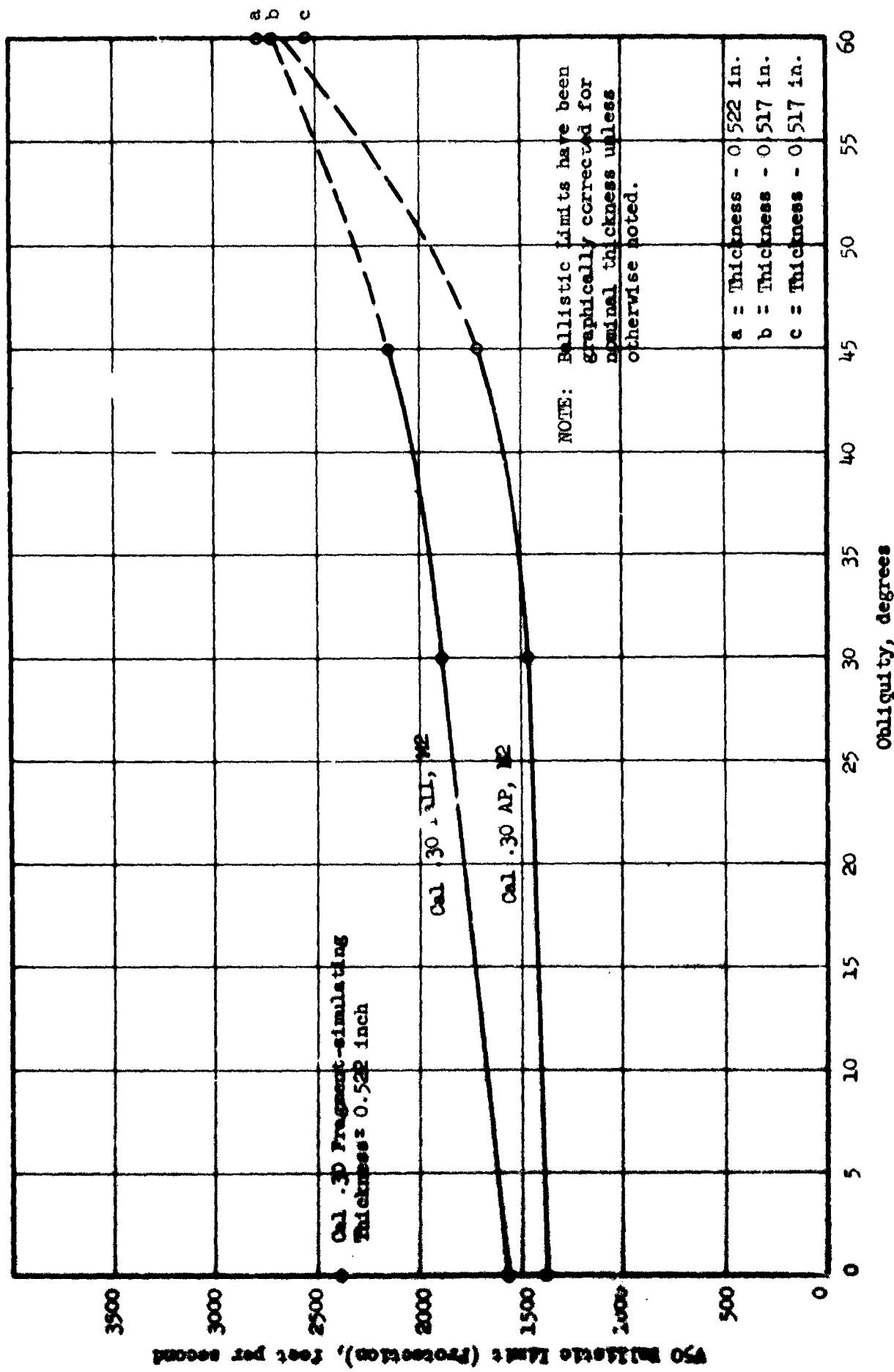
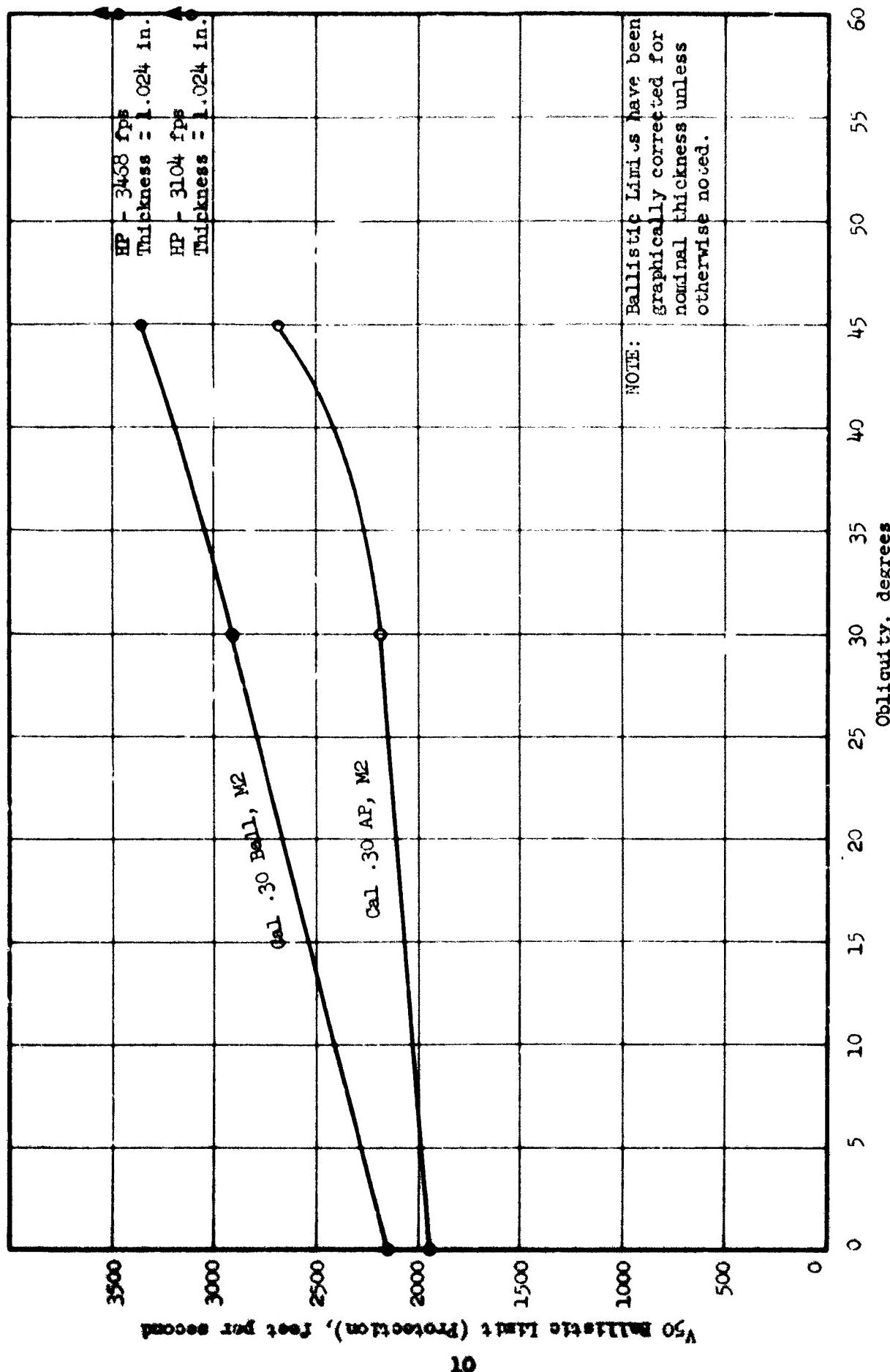


Figure 2: Ballistic Performance of One-Half Inch Aluminum (5083) Plate Against Cal .30 AP, Ball, and Fragment-Simulating Projectiles.

Figure 2

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Figure 3: Ballistic Performance of One Inch Aluminum (5083) Plate Against Cal .30 AP and Ball Projectiles.

Figure 3

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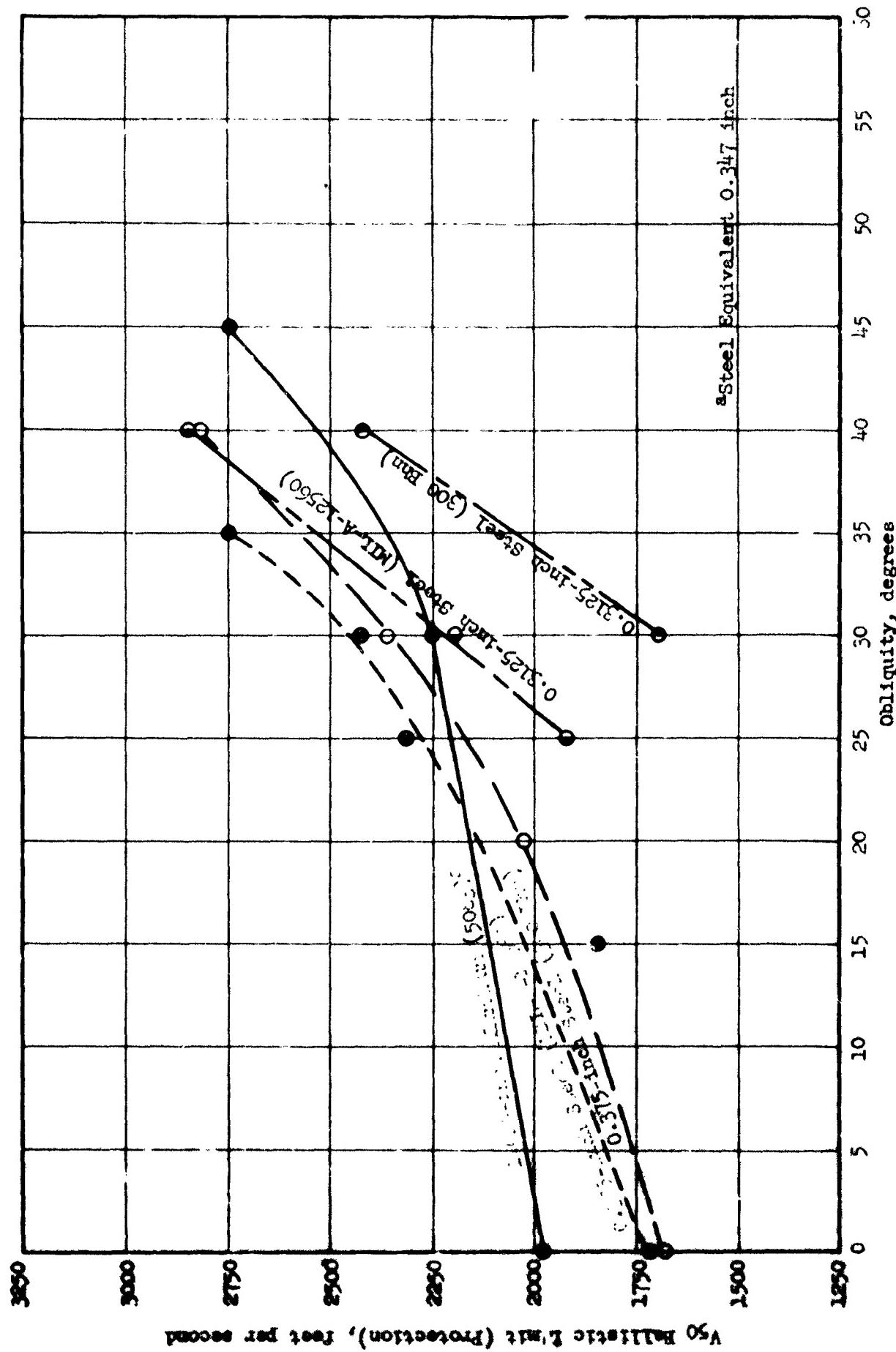


Figure 4: Ballistic Performance of Aluminum Plate (5083) and Steel (MIL-A-12560 and 300 Bhn) Against Caliber .30 AP, M2 Projectiles.

Figure 4

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Figure 4 presents the performance of the aluminum alloy type 5083 with respect to approximate weights of MIL-A-12560 steel (hardness 363-401 Bhn) and 300 Bhn steel armor. The performance of the aluminum armor exceeded that for the steel up to about 25° obliquity. Insufficient data beyond 45° obliquity prevented comparison at the high obliquities. It is realized that aluminum armor primarily is considered as desirable for protection against steel fragments, but the aluminum does give a superior performance to steel at the low obliquities against caliber .30 AP projectiles.

3.2 Observations

In the course of the test it appeared that the aluminum alloy plates used in this test were not homogeneous throughout. There were instances where complete penetrations were obtained on one area of a plate at a given velocity and partial penetrations were obtained on another area at the same or slightly higher velocity. This indicated the aluminum alloy plates might not be homogeneous.

4. (CMH) CONCLUSION

It is concluded from the limited data obtained herein, that the aluminum alloy armor (type 5083) gave a superior performance to an equal weight of steel at obliquities up to 25° when attacked with caliber .30 AP projectiles.

5. (CMH) RECOMMENDATION

Although aluminum alloy armor (type 5083) is considered primarily for steel-fragment protection, ballistic data should be obtained on promising aluminum alloys with small-arms projectiles.

SUBMITTED:

T. J. Griffin
T. J. GRIFFIN
Pfc, Ord Corps
Test Director

REVIEWED:

W.C. Pless
WM. C. PLESS
Chief, Armor Branch

W.A. Gross Jr.
W. A. GROSS, JR.
Chief, Automotive Division

APPROVED:

H. A. Morris
for
H. A. MORRIS
Assistant Deputy Director
for Engineering Testing
Development and Proof Services

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APPENDIX A
Correspondence

Mr. Kleppinger/mca/7120

OJSA-1320

SUBJECT: Ballistic Tests of Aluminum Plates

TO: Commanding General
Aberdeen Proving Ground
Maryland
ATTN: D : PS, Mr. W. C. Please

1. In accordance with the telephone conversation on 17 March 1959 between Mr. W. C. Please of APG and Mr. D. H. Kleppinger of FA, a shipment of aluminum alloy plates will be made to APG within the next week for ballistic testing.

2. The shipment will include the following plates, each plate identifiable by a lot number:

	<u>Number</u>	<u>Size of Plate</u>	<u>Lot Number</u>
1/2" Thickness	1 ea.	30" x 30"	198211
	1 ea.	18" x 36"	008711
	1 ea.	18" x 36"	008712
3/4" Thickness	1 ea.	30" x 30"	183701
	1 ea.	18" x 36"	734-881-1
	1 ea.	18" x 36"	734-881-2
1-1/2" Thickness	1 ea.	18" x 36"	H6285-2
	1 ea.	18" x 36"	H6238-41
	1 ea.	18" x 36"	H6289-40
1-3/4" Thickness	1 ea.	18" x 36"	734-871-2
	1 ea.	18" x 36"	734-871-3

3. It is desired that APG personnel test these plates to obtain ballistic limits under conditions of projectile attack as listed in the following tabulation:

O&D/A-1020

1. JUT: Ballistic tests of aluminum plates

	<u>Proj. calib.</u>	<u>Obliquity of Fire</u>			
1/2" Thick	Cal. .30 Ball	0°	30°	45°	60°
	Cal. .30 AP .2	0°	30°	45°	60°
	Cal. .30 I.S.	0°	-	-	-
3/4" Thick	Cal. .30 Ball	0°	30°	45°	60°
	Cal. .30 AP .2	-	-	-	-
	Cal. .30 I.S.	0°	-	-	-
	Cal. .50 Ball	*	*	*	*
	Cal. .50 AP .2	-	30°	-	-
1-1/2" Thickness	Cal. .30 Ball	0°	30°	-	-
	Cal. .30 AP .2	-	30°	-	-
	Cal. .50 AP .2	-	30°	-	60°
	Cal. .50 Ball	*	*	*	*
1-3/4" Thickness	Cal. .30 Ball	0°	-	-	-
	Cal. .30 AP .2	-	30°	-	-
	Cal. .50 AP .2	-	30°	-	-
	Cal. .50 Ball	*	*	*	*

4. It will be noted that in this tabulation, firings of Cal. .50 Ball ammunition have been marked with an asterisk. It is believed from past experience that these projectiles will function essentially as A. ammunition against this target material. It is suggested that "screening" firings be made at high and low obliquity in an attempt to verify this belief. If the ballistic limits of the Cal. .50 Ball are not significantly different from the Cal. .50 AP .2 in these screenings, further firing of the Cal. .50 Ball is not warranted. The decision of whether to continue firing of the Cal. .50 Ball is left to your experience and judgement.

5. Tests of 1-inch plate mentioned in the phone conversation will be made at a later date. One-inch plate on hand at this arsenal is not representative of the quality of plate which can be produced at this time.

6. It is understood that funds for project T34-005 from O & O are available at APO for these firings.

7. In line with the decision reached at OTAC on 4 March, firings of 1-1/4 inch plate using 20mm I.S. at 0° are in progress at this arsenal. These plates will be forwarded to Arl in the next two weeks for confirmatory firings.

For U. COMMANDS:

R. Morris
Ammunition

ORDNANCE CORPS
FRANKFORD ARSENAL
PHILADELPHIA 37,
PENNSYLVANIA Mr. Kleppinger/mca/3120

IN REPLY

REFER TO: ORDBA-1320

SUBJ (CT: Ballistic Tests of Aluminum Plates

TO: Commanding General
Aberdeen Proving Ground
Maryland
ATTN: D & PS, Mr. W. C. Pless

1. In a letter dated 19 March 1959, this arsenal requested APG to ballistically test a group of aluminum alloy plates. Paragraph 5 of that letter indicated that 1 inch plates would be tested at a later date because representative quality plates were not available at that time.

2. Two plates 30" x 30" x 1" of Al-Mg alloy representing material identified by lot number J6293 have been obtained for these tests, and will be shipped to your installation within the next week.

3. It is requested that these plates be tested in accordance with the following firing schedule using available TB4-005 funding.

	<u>Projectile</u>	<u>Obliquity</u>			
1" Plate	Cal. .30 Ball	0°	30°	45°	60°
	Cal. .30 APM2	0°	30°	45°	60°
	Cal. .50 APM2	-	-	-	60°

4. It is requested that fired plates be retained for possible mechanical and metallurgical tests.

FOR THE COMMANDER:

H.P. GEORGE
Assistant

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ROUND-BY-ROUND DATA

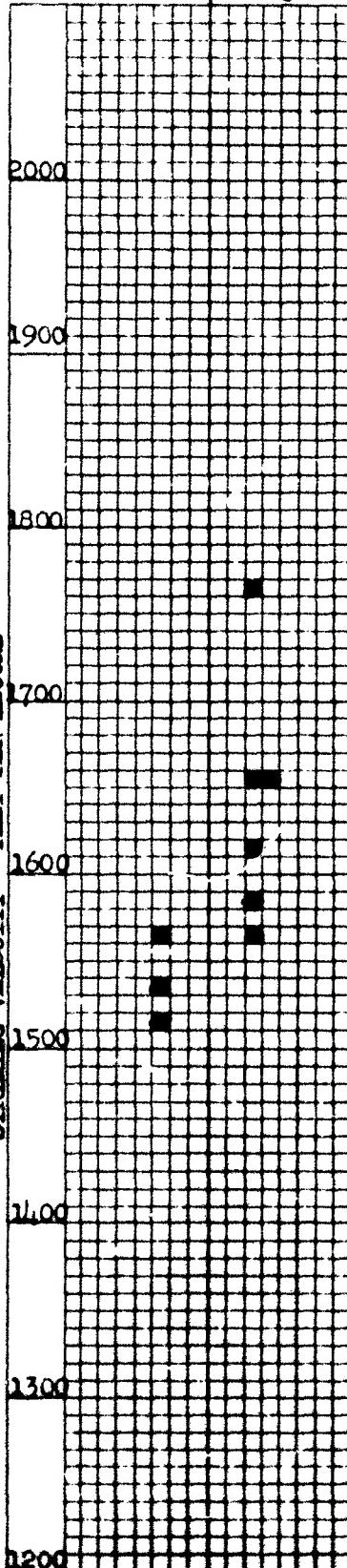
APPENDIX B
Detailed Test Data Sheets
FIRING RECORD 10.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .530" x 30' x 30"
Plate No.: 196211
Weight of Projectile: 14.02315

Projectile: Cal .30 Ball 12
Gun to 1st Screen: 60.65'
1st Screen to 2d Screen: 49.57'
2d Screen to Plate 182.07'
Obliquity: 0°
Powder: 4759
Gun No.: 1402315

DATE: 2 April 1959

Partial Complete



Rd No.	Charge Grains	Velocity fps	Result	Rd No.	Charge Grains	Velocity fps	Result
1	24	1852	Disr.				
2	24	1682	Disr.				
3	24	1766	CP(P)				
4	23	1653	CP(P)				
5	22	Lost	PP(P)				
6	22	1517*	PP(P)				
7	22	1616*	CP(P)				
8	22	Lost	CP(P)				
9	22	1565*	CP(P)				
10	22	Lost	PP(P)				
11	22	Lost	PP(P)				
12	22	Lost	CP(P)				
13	22	Lost	PP(P)				
14	22	1536*	PP(F)				
15	22	1560*	PP(P)				
16	22	1656	CP(P)				
17	22	1589*	CP(P)				

*V50 Ballistic Limit (Protection) = 1564 fps
 High Partial Penetration = 1560 fps
 Low Complete Penetration = 1565 fps
 Spread = 99 fps

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ROUND-BY-ROUND DATA

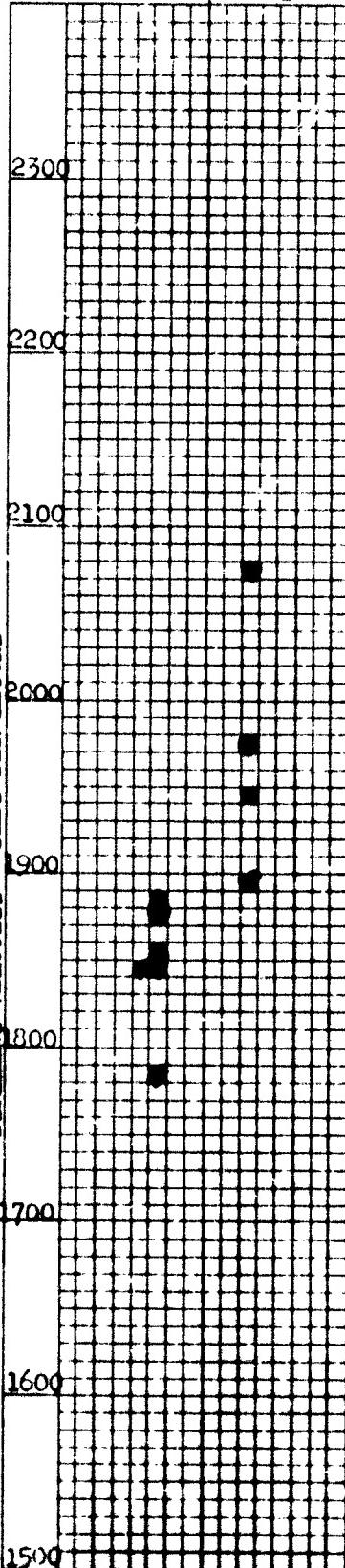
FLYING LABORATORY.

Material: Aluminum
 Submitted by: Frankford
 Type of Test: Development
 Size: .530" x 30" x 30"
 Plate No.
 Total Weight: 138211
 Weight per Rd:

Projectile: Cal .30 Ball M2
 Gun to 1st Screen: 60.65'
 1st Screen to 2d Screen: 40.57'
 2d Screen to Plate 183.67'
 Obliquity: 30°
 Powder: 14759
 Gun No.: 140215

DATE: 2 April 1959

Partial Complete



*V50 Ballistic Limit (Protection) = 1903 fps
 High Partial Penetration = 1885 fps
 Low Complete Penetration = 1897 fps
 Spread = 120 fps

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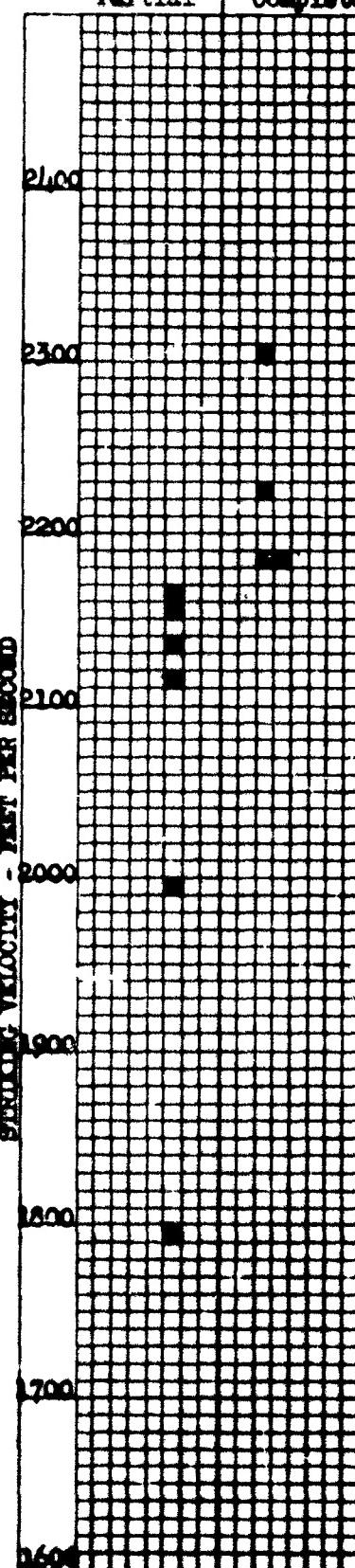
FIRING RECORD NO.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .530" x 30" x 30"
Thickness Plate No.
Submitted by: 198211
Manufactured by:

Projectile: Cal .30 Ball M2
 Gun to 1st Screen: 60.65°
 1st Screen to 2d Screen: 49.57°
 2d Screen to Plate 188.46°
 Obliquity: 45°
 Powder: 4759
 Gun No.: 44747

DATE: 1 April 1959

Partial Complete



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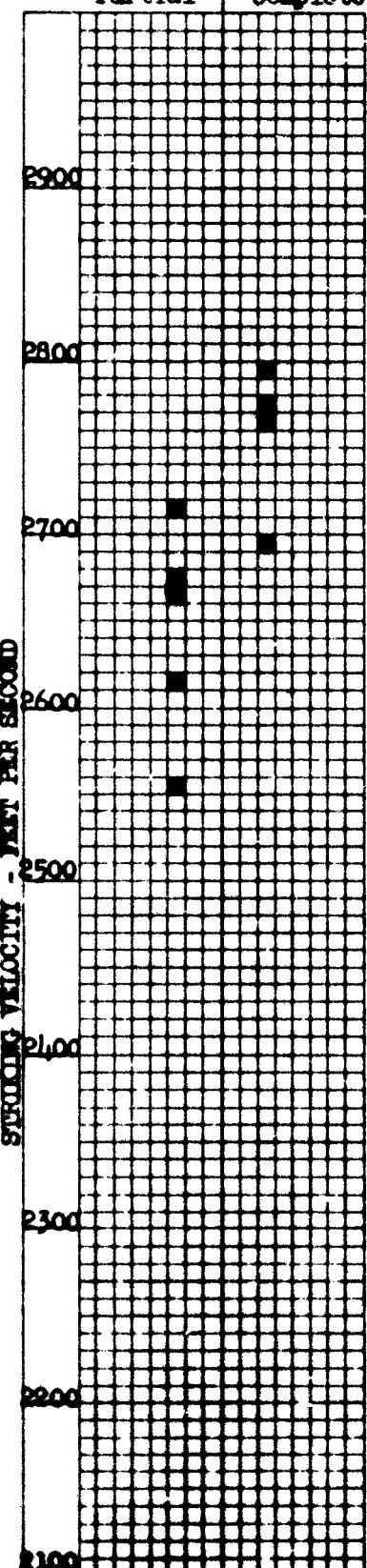
FIRING RECORD NO.

DATE: 1 April 1959

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .517" x 18" x 36"
SUBMITTER Plate No.
Harrington 008711
Manufactured

Projectile: Cal .30 Ball M2
 Gun to 1st Screen: 60.65°
 1st Screen to 2d Screen: 49.45°
 2d Screen to Plate 158.46°
 Obliquity: 60°
 Powder: 24664
 Gun No.: 14717

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	58	2702	Diss.				
2	58	2554	PP(P)				
3	62	Lost	CP(P)				
4	60	Lost	PP(P)				
5	60	2617	PP(P)				
6	61	2715*	PP(P)				
7	62	2797	CP(P)				
8	61	2761*	CP(P)				
9	61	2695*	CP(P)				
10	61	2678*	PP(P)				
11	61	2665*	PP(P)				
12	61	2775*	CP(P)				
0.750 Ballistic Limit (Protection) = 2715 fpm							
High Partial Penetration				= 2715 fpm			
Low Complete Penetration				= 2695 fpm			
Speed				= 110 fpm			



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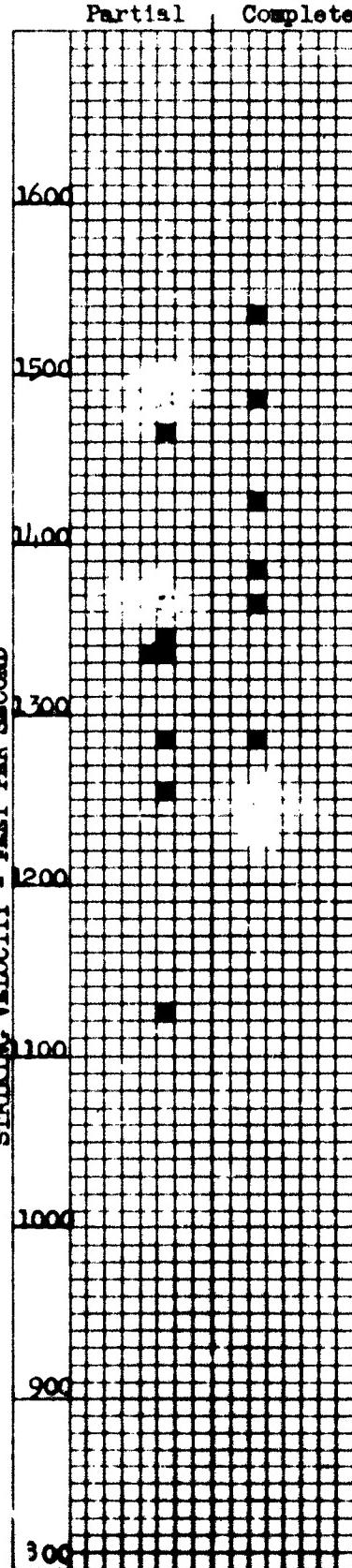
ROUNDLY-ROUND SHABIZED

FILING RECORD

DATE: 31 March 1959

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .522" x 18" x 36"
~~RECEIVED~~ Plate No.
~~RECEIVED~~ 008712
~~RECEIVED~~

Projectile: Cal .30 AP M2
Gun to 1st Screen: 23.83°
1st Screen to 2d Screen: 32.62°
2d Screen to Plate 235.83°
Obliquity: 0°
Powder: 4759
Gun No.: 140245



•v50 Ballistic Limit (Protection)	= 1370 fpp
High Partial Penetration	= 1165 fpp
Low Complete Penetration	= 1282 fpp
Spread	= 205 fpp

[REDACTED]

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~~MODIFIED ROUND STICKS AUTHORIZED~~

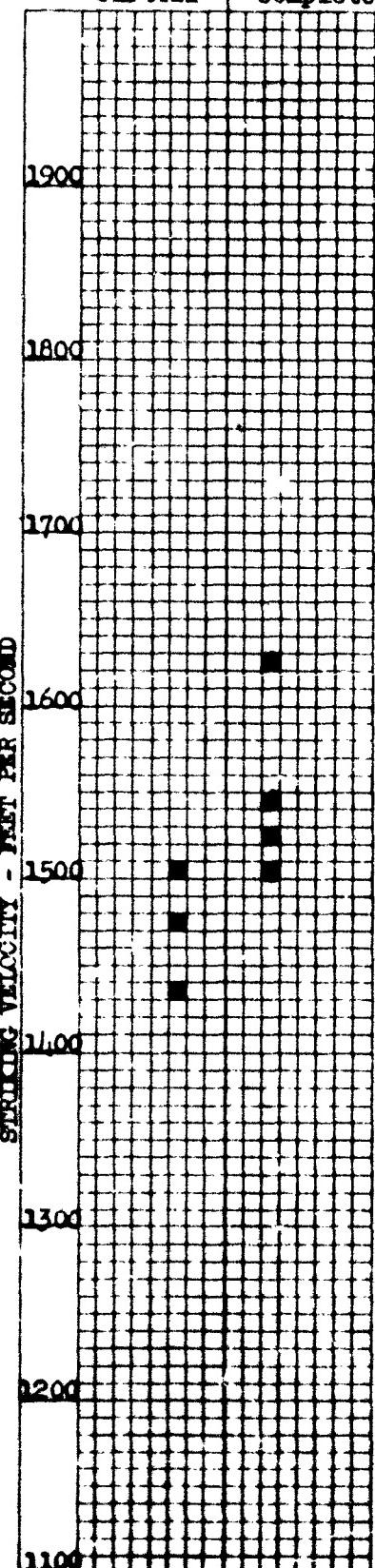
FIRING RECORD NO.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .522" x 18" x 36"
~~Specimen~~ Plate No.
~~Specimen~~ 008712
~~Specimen~~

Projectile: Cal .30 AP M2
 Gun to 1st Screen: 25.83'
 1st Screen to 2d Screen: 32.62'
 2d Screen to Plate 237.43'
 Obliquity: 30°
 Powder: 4759
 Gun No.: 1102245

DATE: 31 March 1959

Partial Complete



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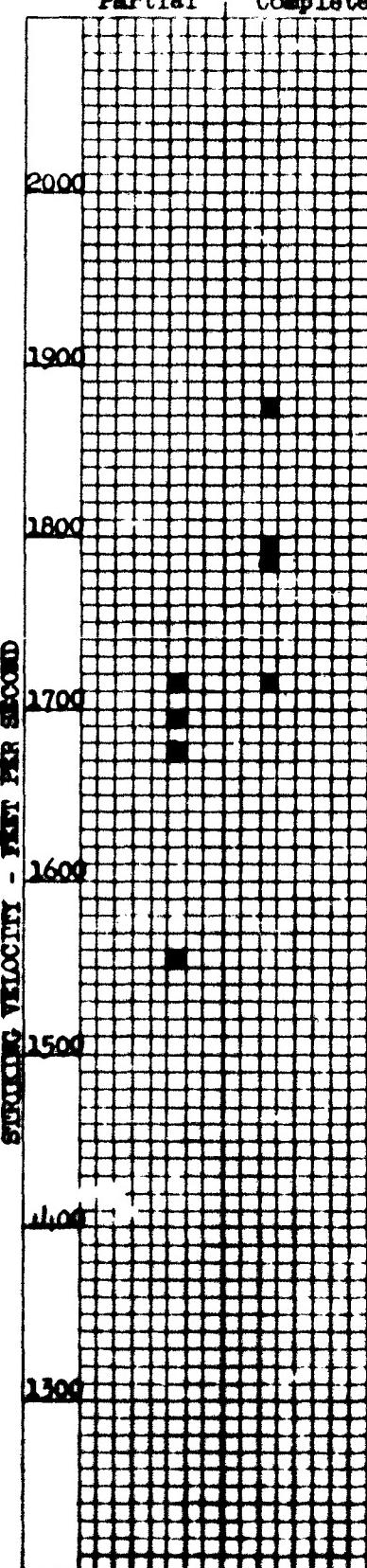
MOTORISED-BY-ROUND-DATA-HORIZON **FIRING RECORD NO.**

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .522" x 18" x 36"
Thickness Plate No.
008712

Projectile: Cal .30 AP M2
 Gun to 1st Screen: 23.83°
 1st Screen to 2d Screen: 32.62°
 2d Screen to Plate 240.48°
 Obliquity: 45°
 Powder: 4759
 Gun No.: 1402245

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DATE: 31 March 1999



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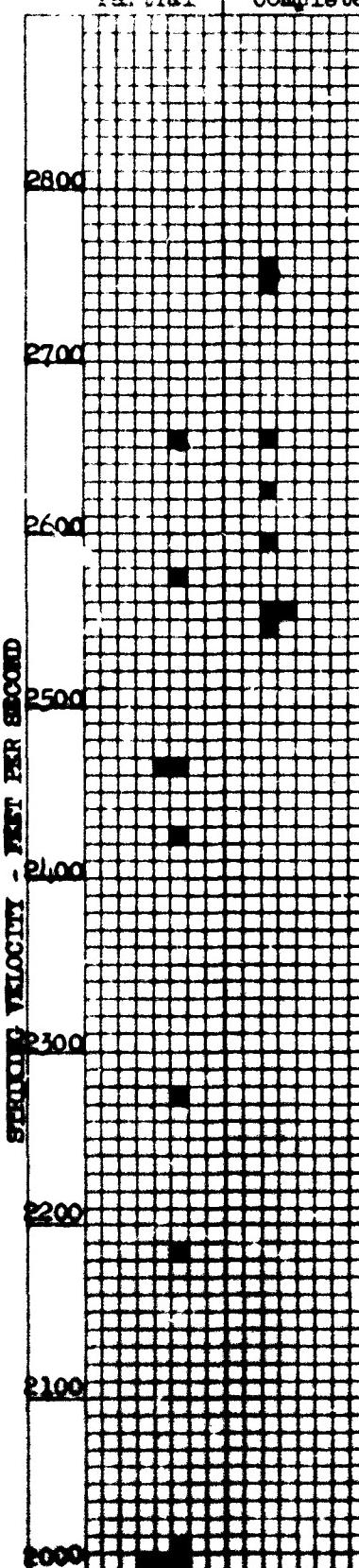
ROUND-BY-ROUND DATA 1/11

FIRING RECORD NO.

DATE: 31 March - 1 April 1959

Material: Aluminum
Submitted by: Frankford Ars.
Type of Test: Development
Size: .517" x 18" x 36"
Picmax Pl. No.
Zincite No.: 008711
Weight of projectile

Projectile: Cal .30 AP, M2
Gun to 1st Screen: 23.83'
1st Screen to 2d Screen: 32.62'
2d Screen to Plate 242.23'
Obliquity: 60°
Powder: 4759 - 24664
Gun No.: 1102245 - 44747



Rd No.	Charge Grains	Velocity fps	Result	Rd No.	Charge Grains	Velocity fps	Result
1	27	1941	PP(P)	16	61	2753	CP(P)
2	28	1926	PP(P)	17	60	2711	Dis.
3	29	2016	Dis.	18	59	2627*	CP(P)
4	29	1973	PP(P)	19	58	Lost	CP(P)
5	32	2186	PP(P)	20	58	2550*	CP(P)
6	36	2270	PP(P)	21	58	Lost	PP(P)
7	38.5	2421*	PP(P)	22	58	2590	Dis.
8	40	Lost	PP(P)	23	58	2558*	CP(P)
CHANGED GUN TO .300 MAGNUM NO. 44747				24	58	2595*	CP(P)
9	58	2469*	PP(P)	25	58	Lost	PP(P)
10	62	2916	Dis.	26	58	2462*	PP(P)
11	62	2746	CP(P)	27	58	2546*	CP(P)
12	60	2656*	PP(P)	28	58	2577*	PP(P)
13	61	Lost	PP(P)				
14	61	2653	CP(P)				
15	62	2748	Dis.				

•V50 Ballistic Limit (Protection)	= 2516 fpm
High Partial Penetration	= 2559 fpm
Low Complete Penetration	= 2516 fpm
Spread	= 235 fpm

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ROUND-BY-ROUND DATA

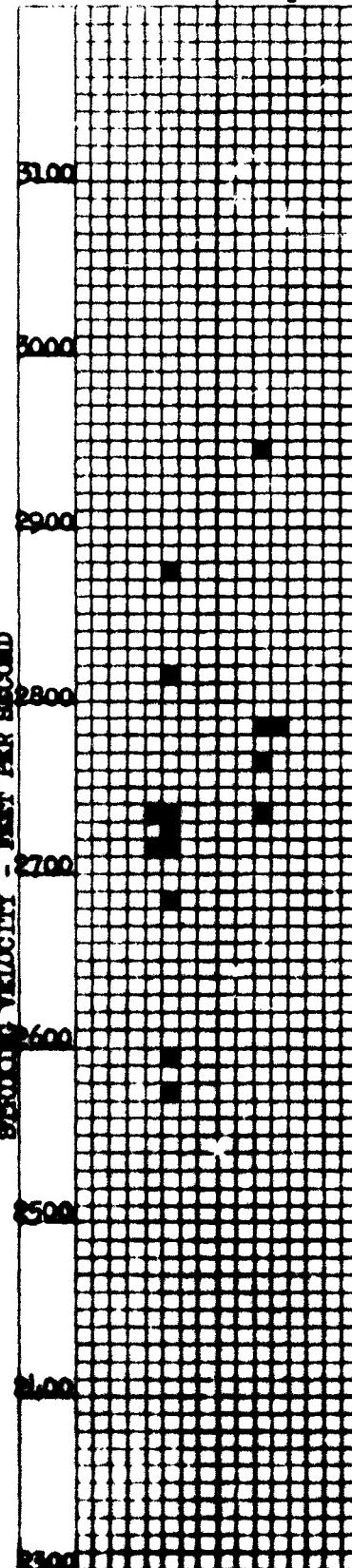
FILEING RECORD NO.

Material: Aluminum
 Submitted by: Frankford Ars.
 Type of Test: Development
 Size: .522" x 18" x 36"
 PRIMER Pl. No.
 Test Number: 008712
 Weight per shot:

Projectile: Cal .30 AP, M2
 Gun to 1st Screen: 8.07'
 1st Screen to 2d Screen: 11.92'
 2d Screen to Plate 16.35'
 Obliquity: 60°
 Powder: 24664
 Gun No.: 44747

DATE: 24 April 1959

Partial, Complete



Rd No.	Charge Grains	Velocity fps	Result	Rd No.	Charge	Velocity	Result
1	58	2942*	CP(P)				
2	56	2782*	CP(P)				
3	53	2593	PP(P)				
4	54	2764*	CP(P)				
5	53	2571	PP(P)				
6	54	Last	PP(P)				
7	54	2688	PP(P)				
8	54	2738*	PP(P)				
9	54	2719	PP(P)				
10	55	2713	PP(P)				
11	55	2732*	PP(P)				
12	56	2870*	PP(P)				
13	56	2815*	PP(P)				
14	56	2725*	PP(P)				
15	56	2782*	CP(P)				
16	56	2732*	CP(P)				
*V50 Ballistic Limit (Protection) = 2788 fps							
High Partial Penetration = 2670 fps							
Low Complete Penetration = 2732 fps							
Speed = 217 mph							
CONFIDENTIAL							
MODIFIED HANDLING AUTHORIZED							

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ROUND-BY-ROUND DATA

Material: Aluminum
 Submitted by: Frankford Ars.
 Type of Test: Development
 Size: .522" x 18" x 36"
 Pl. No. 008712
 Mfgt. No.: 1402245

Projectile: Cal .30 Fragment-Simulating
 Gun to 1st Screen: 11.66'
 1st Screen to 2d Screen: 10.02'
 2d Screen to Plate 9.00'
 Obliquity: 0°
 Powder: 4759
 Gun No.: 1402245

DATE: 13 April 1959

Partial Complete

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	40	3465	CP(P)	17	22	2409*	CP(P)
2	30	3037	CP(P)	18	22	2378	Dis.
3	25	2678	CP(P)	19	22	2427*	CP(P)
4	20	1967	PP(P)				
5	22	2611	CP(P)				
6	20	2214	PP(P)				
7	21	2427*	PP(P)				
8	?!	2343*	CP(P)				
9	21	2204	PP(P)				
10	21	2109	PP(P)				
11	22	2492	CP(P)				
12	22-	2513	CP(P)				
13	21 -	1551	PP(P)				
14	21	2214	Dis.				
15	22 -	2343*	PP(P)				
16	22 -	2343*	PP(P)				

*V50 Ballistic Limit (Protection) = 2382 f/s
 High Partial Penetration = 2427 f/s
 Low Complete Penetration = 2343 f/s
 Spread = 84 f/s

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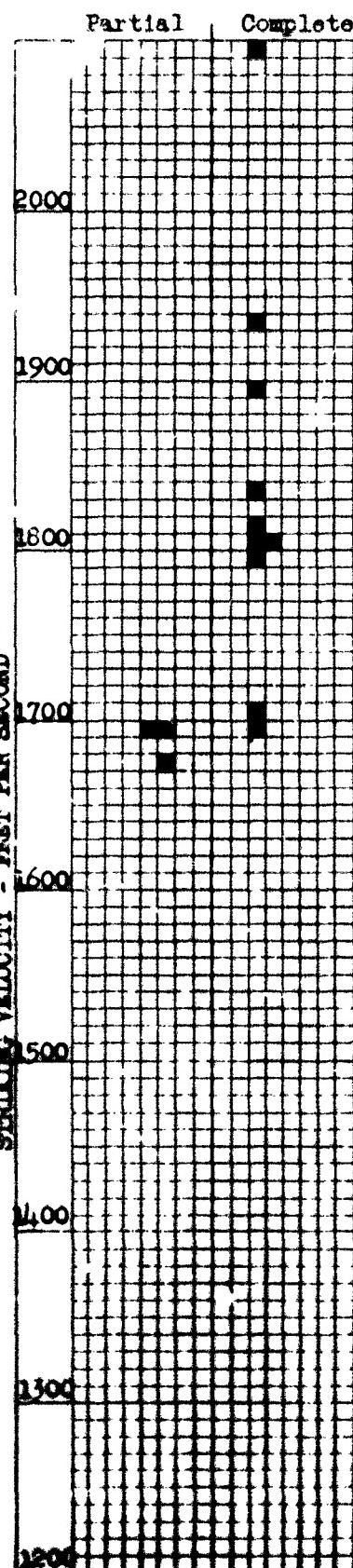
ROUND-BY-ROUND DATA

Firing Rec'd To

Material: Aluminum
 Submitted by: Frankford
 Type of Test: Development
 Size: .768" x 18" x 36"
 Pl. No.
 734-881(2)
 Gun No.: 1102245

Projectile: Cal .30 Ball M2
 Gun to 1st Screen: 60.65'
 1st Screen to 2d Screen: 49.57'
 2d Screen to Plate 182.07'
 Obliquity: 0°
 Powder: 4759

Date: 2 April 1959



*150 Ballistic Limit (Protection) = 1711 f/s
 High Partial Penetration = 1694 f/s
 Low Complete Penetration = 1699 f/s
 Spread = 1722 f/s

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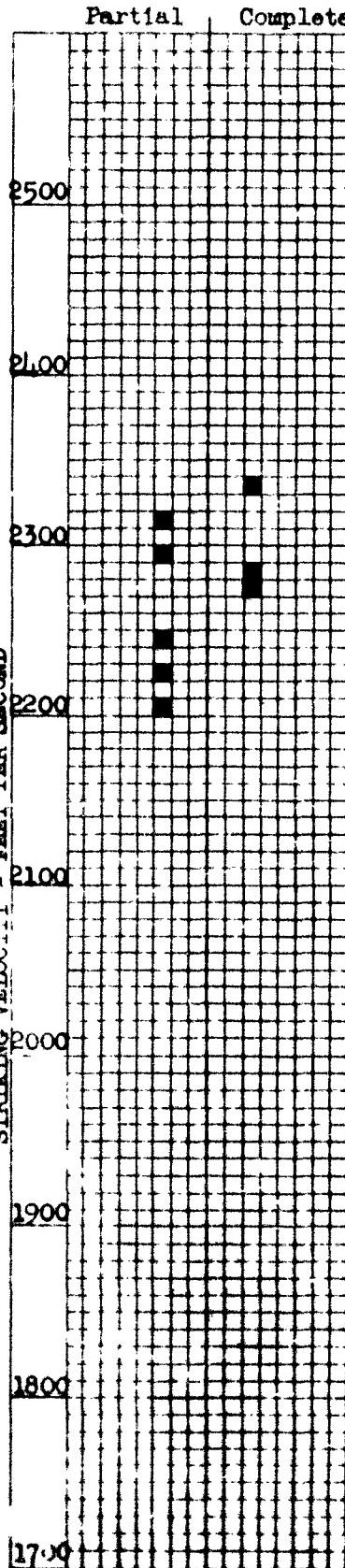
ROUND-BY-ROUND ADVICE

FILING RECORD

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .768" x18" x36"
Pl. No.
734-881(2)

Projectile: Cal..30 Ball ~~M2~~
 Gun to 1st Screen: 60.65'
 1st Screen to 2d Screen: 49.57'
 2d Screen to Plate 183.67'
 Obliquity: 30°
 Powder: 4759
 Gun No.: 1102245

DATE: 2 April 1959



•V50 Ballistic Limit Protection	= 2292 fps
High Partial Penetration	= 2313 fps
Low Complete Penetration	= 2275 fps
Spread	= 90 fps

CONTRIBUTED
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ROUND-BY-ROUND DATA

FIRING RECORD NO.

Material: Aluminum
 Submitted by: Frankford Ars.
 Type of Test: Development
 Size: .760" x 18" x 36"
 Pl. No. 734-881 (2)
 Gun No.: 1402245 - 14747

Projectile: Cal .30 Ball, M2
 Gun to 1st Screen: 60.65'
 1st Screen to 2d Screen: 49.57'
 2d Screen to Plate 187.07'
 Obliquity: 45°
 Powder: 4759 - 24664
 Gun No.: 1402245 - 14747

DATE: 3 April 1959

Partial Complete

3100

3000

2900

2800

2700

2600

2500

2400

2300

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	40	2614*	PP(P)				
CHANGED GUN TO 300 MAGNUM NO. 14747							
2	62	2822	CP(P)				
3	60	2666*	PP(P)				
4	61	2683*	CP(P)				
5	61	2730*	PP(P)				
6	61	2736*	CP(P)				
7	61	2748	CP(P)				
8	61	2760	CP(P)				
9	60	2713*	CP(P)				
*V50 Ballistic Limit (Protection) = 2690 fpm							
High Partial Penetration = 2730 fpm							
Low Complete Penetration = 2603 fpm							
Speed = 2625 fpm							
CONFIDENTIAL							
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CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED**ROUND-BY-ROUND DATA**

FIRING RECORD NO.

DATE: 3 April 1999

Material: Aluminum Projectile: Cal .30 Ball, M2
 Submitted by: Frankford Ars. Gun to 1st Screen: 60.65' 11.53'
 Type of Test: Development 1st Screen to 2d Screen: 49.57' - 10.61'
 Size: .766" x 18" x 36" 2d Screen to Plate 188.46' - 15.70'
 Pl. No. Obliquity: 60°
 Test No.: 734-881(1) Powder: 24664
 Weight: Gun No.: 44747

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
	Grains	fps					
1	70	3123	PP(P)				
CHANGED DISTANCES, NEW PLATE NO. 183701, SIZE .794"x30"x30"							
2	70	3352	PP(P)				
3	72	3481	PP(P)				
4	74	3569	PP(P)				
5	75	3595	PP(P)				
No Ballistic Limit obtained							
High Partial Penetration = 3505 Cm							
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2 Dec 51)

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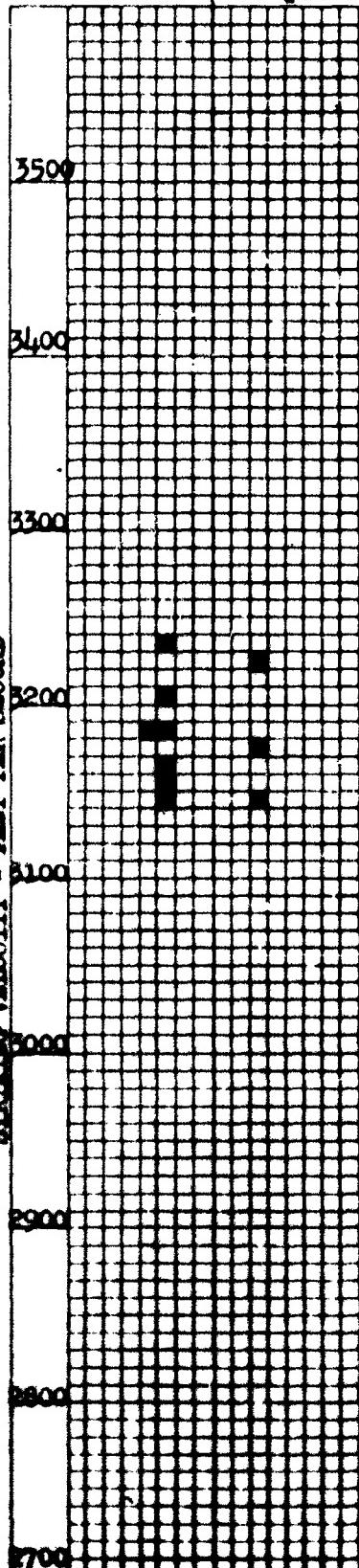
FIRING RECORD NO.

Material: Aluminum
 Submitted by: Frankford
 Type of Test: Development
 Size: .766" x 18" x 36"
 Plate No.
 Test-Master: 734-881(1)
 Weight-Density:

Projectile: Cal. .30 AP 12
 Gun to 1st Screen: 60.65'
 1st Screen to 2d Screen: 49.57'
 2d Screen to Plate 188.46'
 Obliquity: 60°
 Powder: 24664
 Gun No.: 44747

DATE: 3 April 1959

Partial Complete



Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	Grains 70	fps lost	DISR.				
2	70	3219	DISR.				
3	70	3203	PP(P)				
4	70	3175*	CP(P)				
5	70	3142*	CP(P)				
6	70	3146	PP(P)				
7	70	3168	PP(P)				
8	70	3152	PP(P)				
9	70 +	3181	PP(P)				
10	70 +	3189*	PP(P)				
11	70 +	3233*	PP(P)				
12	70 +	3218*	PP(P)				
13	70 +	3224*	CP(P)				

*V50 Ballistic Limit (Protection) = 3196 fps
 High Partial Penetration = 3233 fps
 Low Complete Penetration = 3142 fps
 Spread = 91 fps

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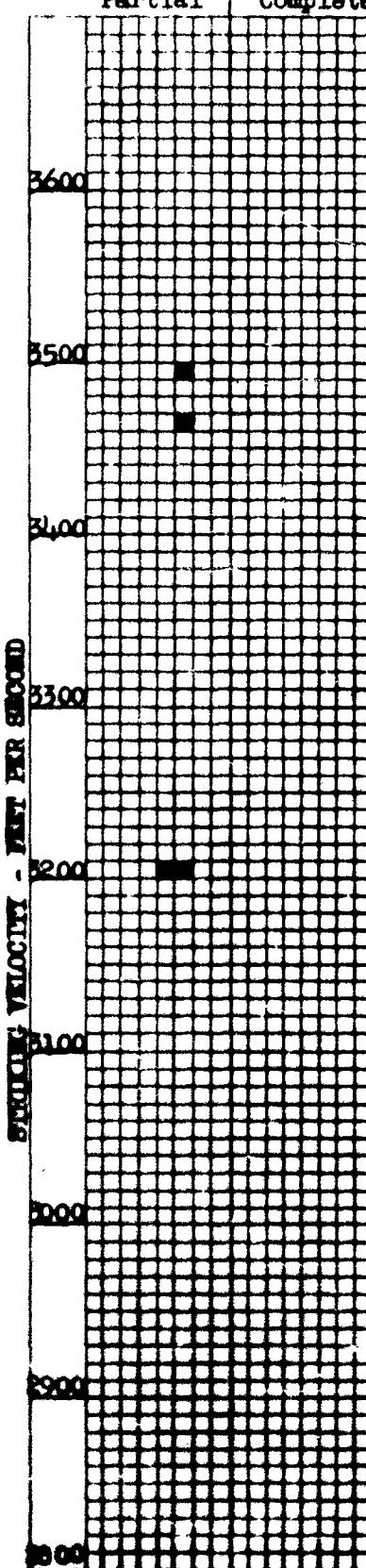
CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

ROUND-BY-ROUND DATA

FLIRING RECORD NO.

DATE: 10 April 1959

Material: Aluminum	Projectile: Cal .30 Fragment-Sil
Submitted by: Brookford Ars.	Gun to 1st Screen: 11.65'
Type of Test: Development	1st Screen to 2d Screen: 10.03'
Size: .794" x 30" x 30"	2d Screen to Plate 8.93'
Picture Pl. No.	Obliquity: 0°
Exhibit No.: 183701	Powder: 4759 - 24664
Weight of projectile	Gun No.: 140245 - 44747



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RBAC 303 Rev 1
3 Dec 93

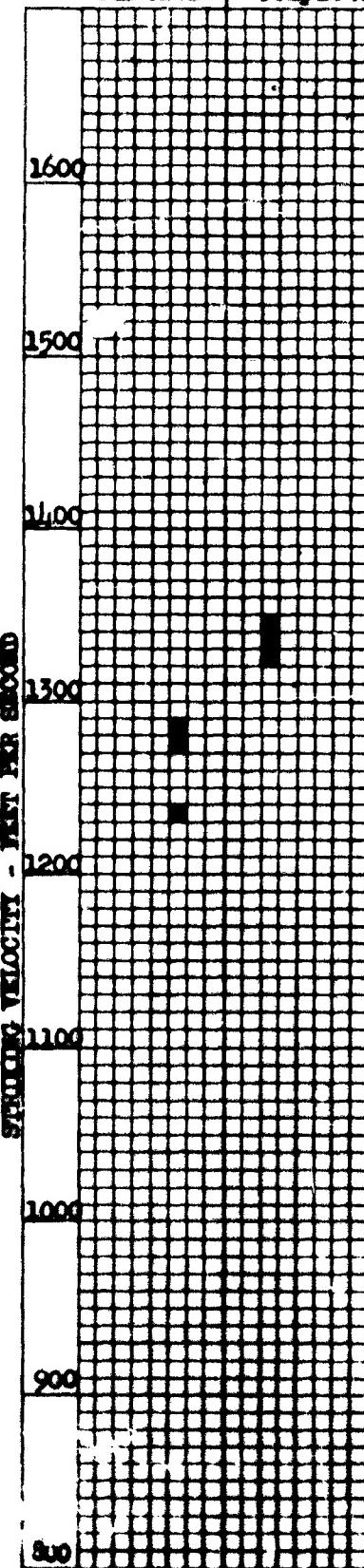
MODIFIED HANDBOOK OF AUTHORIZED

FILED RECORD NO.

Material: Aluminum	Projectile: Cal .50 AP M2
Submitted by: Frankford	Gun to 1st Screen: 60.63'
Type of Test: Development	1st Screen to 2d Screen: 49.71'
Size: .766" x 18" x 36"	2d Screen to Plate 183.29'
Plate No.	Obliquity: 30°
Test Number: 734-881 (1)	Powder: 35683
Manufacturer:	Gun No.: 22

DATE: 7 April 1959

Partial | Complete



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~~MODIFIED ROTATING ROUND AUTHORIZED~~

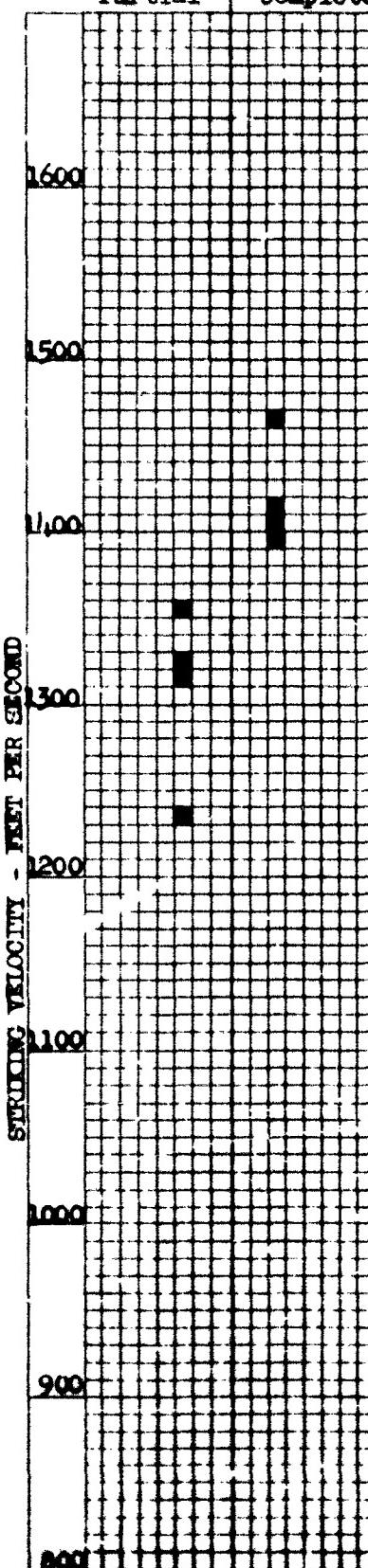
FIRING RECORD NO.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: .766" x 18" x 36"
Thickness Plate No.
734-881(1)

Projectile: Cal .50 Ball M2
 Gun to 1st Screen: 60.63°
 1st Screen to 2d Screen: 49.71°
 2d Screen to Plate 183.29°
 Obliquity: 30°
 Powder: 35683
 Gun No.: 22

DATE: 7 April 1999

Partial Complete



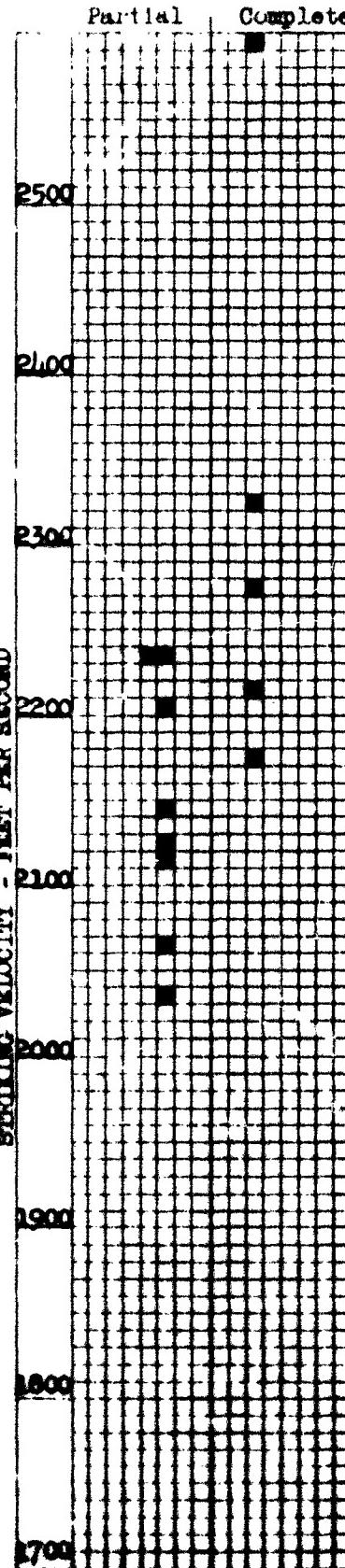
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ROUND-BY-ROUND DATA

Material: Aluminum	Projectile: Cal .30 Ball #2
Submitted by: Frankford Arc.	Gun to 1st Screen: 11.68°
Type of Test: Development	1st Screen to 2d Screen: 10.04°
Size: 1.024" x 30" x 30"	2d Screen to Plate 8.94°
Plates	Obliquity: 0°
Pl. No.	Powder: 4759
Number ; J6293 Pl #1	Gun No.: 1512536
Material	

DATE: 14 April 1959



+V50 Ballistic Limit (Protection = 221 fpm)
High Partial Penetration = 2250 fpm
Low Complete Penetration = 2176 fpm
Spall = 25 fpm

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ROUND-BY-ROUND DATA

FIREARM TESTED: J.

Material: Aluminum Projectile: Cal .30 Ball, M2 DATE: 14 April 19
 Submitted by: Frankford Ars. Gun to 1st Screen: 11.68' 7.95' 16 April 19
 Type of Test: Development 1st Screen to 2d Screen: 10.04' 12.00' Partial Complete
 Size: 1.024" x 30" x 30" 2d Screen to Plate 10.34' 10.65'
 Pl. No. Obliquity: 30°
 Pl. #1 Powder: 4759 - 24664
 Gun No.: 1512536 - 44747

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	32	2419	PP(P)				
2	35	2556	PP(P)				
3	40	2816	PP(P)				
CHANGED GUN, .300 MAGNUM NO. 44747							
4	70	3496	CP(P)				
5	62	3048	CP(P)				
6	57	2857	Dia.				
7	59	2980+	CP(P)				
8	57	2865	PP(P)				
9	58	2879	PP(P)				
10	59	2914+	PP(P)				
11	60	3025+	CP(P)				
12	59	2950+	PP(P)				
13	59	2980+	PP(P)				
14	59+	2995+	CP(P)				
.30 Ballistic Limit (Protection) = 2774 f.p.s.							
High Partial Penetration = 2400 f.p.s.							
Low Complete Penetration = 2300 f.p.s.							
Spread = 111 f.p.s.							
CONFIDENTIAL							
MODIFIED HANDLING AUTHORIZED							

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ROUND-BY-ROUND DATA

FIGURE 10 (Continued).

Material: Aluminum Projectile: Cal .30 Ball, M2
 Submitted by: Frankford Ars. Gun to 1st Screen: 11.68'
 Type of Test: Development 1st Screen to 2d Screen: 10.04'
 Size: 1.024" x 30" x 30" 2d Screen to Plate 13.74'
 Pl. No. Obliquity: 49°
 4293 Pl. #1 Powder: 24664
 Gun No.: 44747

DATE: 15 April 1959

Partial Complete

3600
3500
3400
3300
3200
3100
3000
2900
2800

• V50 Ballistic Limit (Protection)	=	3,24	fps
High Partial Penetration	=	3,32	fps
Low Complete Penetration	=	3,32	fps
Spread	=	59	fps

~~CONFIDENTIAL~~
~~MODIFIED HANDLING AUTHORITY~~

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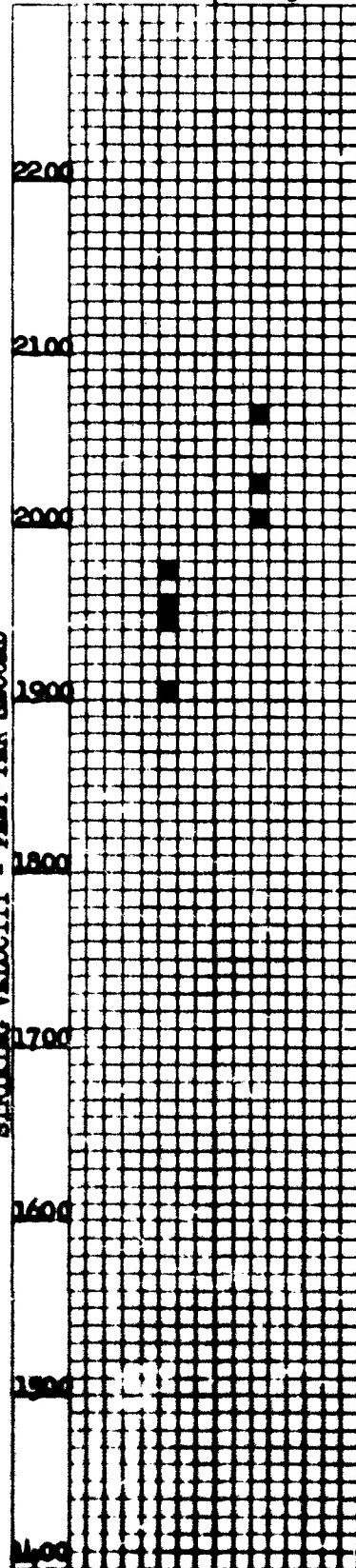
ROUND-BY-ROUND DATA

FLYING RECORD NO.

Material: Aluminum Projectile: Cal .30 AP, M2
Submitted by: Frankford Ars. Gun to 1st Screen: 11.66'
Type of Test: Development 1st Screen to 2d Screen: 10.02'
Size: 1.024" x 30" x 30" 2d Screen to Plate 9.00'
Elevation Pl. No. Obliquity: 0°
~~Experiments~~ 36293 Pl. #1 Powder: 4759
~~Water~~ Gun No.: 1512536

DATE: 13 April 1959

Partial Complete



• 1950 Ballistic Limit (Protection)	=	1995 Spec
High Partial Penetration	=	1995 Spec
Low Complete Penetration	=	2009 Spec
Impact	=	117 Spec

~~MODIFIED DATE~~ ~~MR. AUTHORIZED~~

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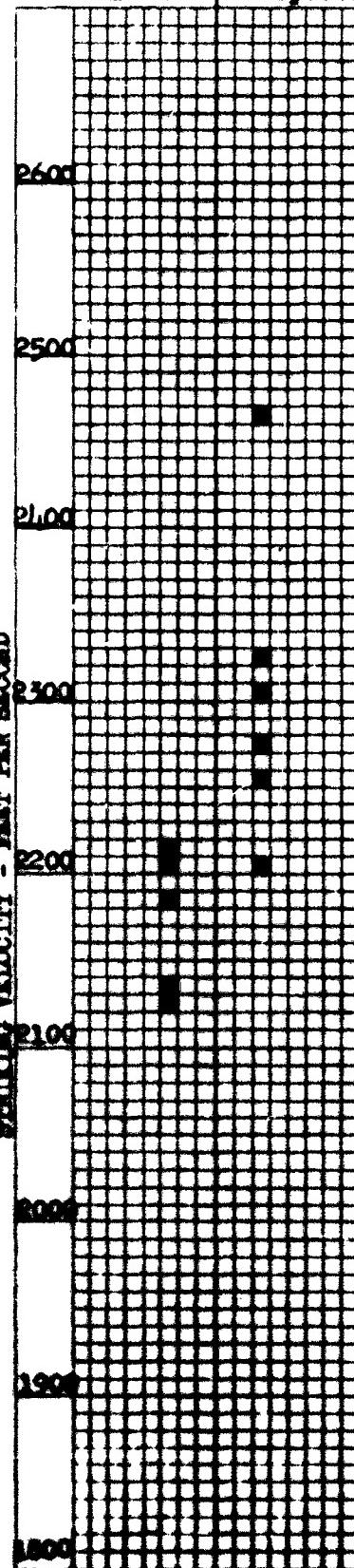
ROUND-BY-ROUND DATA

Material: Aluminum
Submitted by: Frankford Ars.
Type of Test: Development
Size: 1.024" x 30" x 30"
Mark Pl. No.
Submitted by: J6293 Pl. #1
Marked by:
Projectile: Cal .30 AP, M2
Gun to 1st Screen: 11.68'
1st Screen to 2d Screen: 10.04'
2d Screen to Plate 10.34'
Obliquity: 30°
Powder: 4759
Gun No.: 1512536

FIRING RECORD NO.

DATE: 14 April 1959

Partial Complete



~~CONFIDENTIAL~~

MODIFIED HANDLING AUTHORITY

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

ROUND-BY-ROUND DATA

FIRING RECORD NO.

Material: Aluminum
 Submitted by: Frankford Ars.
 Type of Test: Development
 Size: 1.024" x 30" x 30"
~~Pl. No.~~ Pl. No. 56293 Pl. #1
~~Test Number~~ Gun No.: 4759 - 24664
~~Weight~~ Gun No.: 1512536 - 44747

DATE: 14 April 1959

Partial Complete

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	36	2529	PP(P)	17	56	Lost	Dis.
2	40	2723*	PP(P)	18	56	2761*	CP(P)
CHANGED GUN .300 MAGNUM NO. 44747							
3	70	3433	Dis.	19	56 -	2735*	PP(P)
4	73	3433	Dis.				
5	70	3386	CP(P)				
6	65	3264	CP(*)				
7	60	Lost	CP(P)				
8	56	2612*	CP(P)				
9	54	2617	PP(P)				
10	56	2750*	PP(P)				
11	57	2836	CP(P)				
12	56	2886	CP(P)				
13	56	2836	CP(P)				
14	55 -	2720*	CP(P)				
15	54	2683	PP(P)				
16	55	2676	PP(P)				
 •V50 Ballistic Limit (Protection) = 2754 fps							
High Penetration = 2750 fps							
Low Complete Penetration = 2720 fps							
Spread = 92 fps							
 CONFIDENTIAL HANDLING AUTHORIZED							
MODIFIED HANDLING AUTHORIZED							

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CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

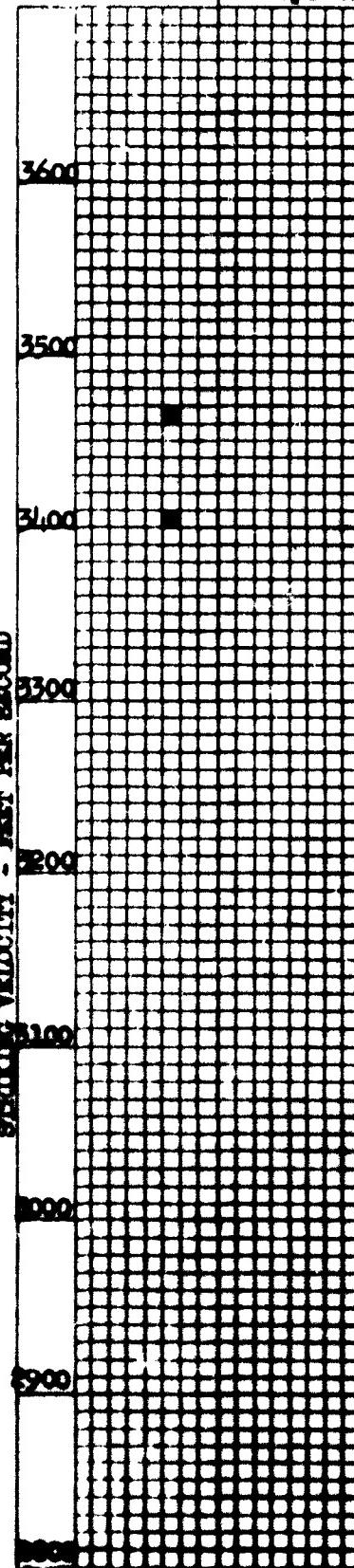
ROUND-BY-ROUND DATA

FILED IN REC RD NO.

Material: Aluminum Projectile: Cal .30 AP, M2
Submitted by: Frankford Ars. Gun to 1st Screen: 11.68'
Type of Test: Development 1st Screen to 2d Screen: 10.04'
Size: 1.024" x 30" x 30" 2d Screen to Plate 15.34'
Pl. No. Obliquity: 60°
Subtest No.: J6293 Pl. #1 Powder: 24664
Weight per round: 1.024" Gun No.: 44747

DATE: 15 April 1959

Partial Complete



No Ballistic Limit Obtained
With Partial Penetration - 3168 ft/sec

CONFIDENTIAL

MODIFIED HANDLING AUTHORIZED

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

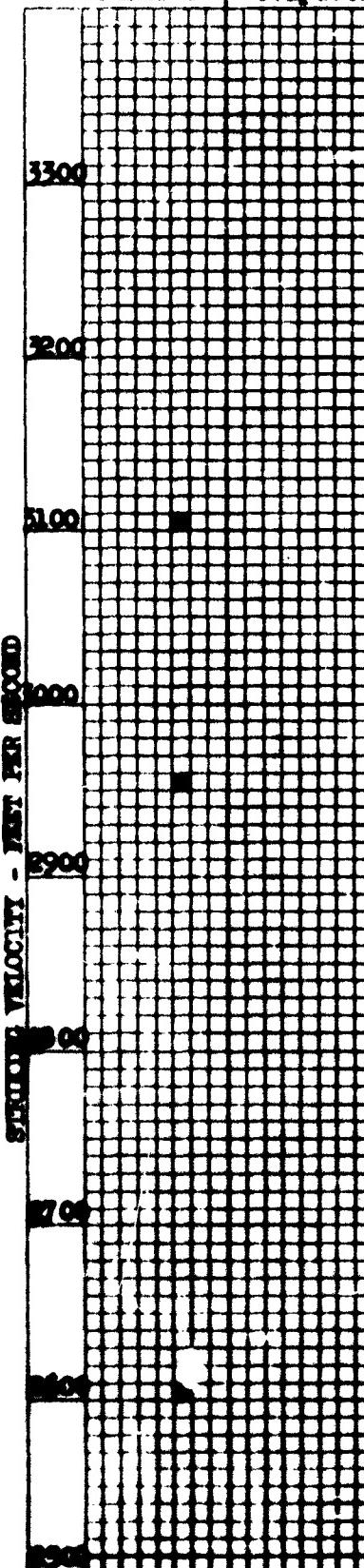
ROUND-BY-ROUND DATA

FILED RECORD NO.

Material: Aluminum
Submitted by: Frankford Ars.
Type of Test: Development
Size: 1.024" x 30" x 30"
Zinc Pl. No.
Zinc Pl. No.: 36293 Pl. #2
Obliquity: 60°
Powder: 35683
Gun No.: 22

DATE: 16 April 1959

Partial | Complete



~~CONFIDENTIAL~~
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CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

ROUND-BY-ROUND DATA

FIRING RECORD NO.

Material: Aluminum
 Submitted by: Frankford
 Type of Test: Development
 Size: 1.497" x 18" x 36"
~~Pl. No.~~
~~Thickness~~ 16289-40
~~Weight~~

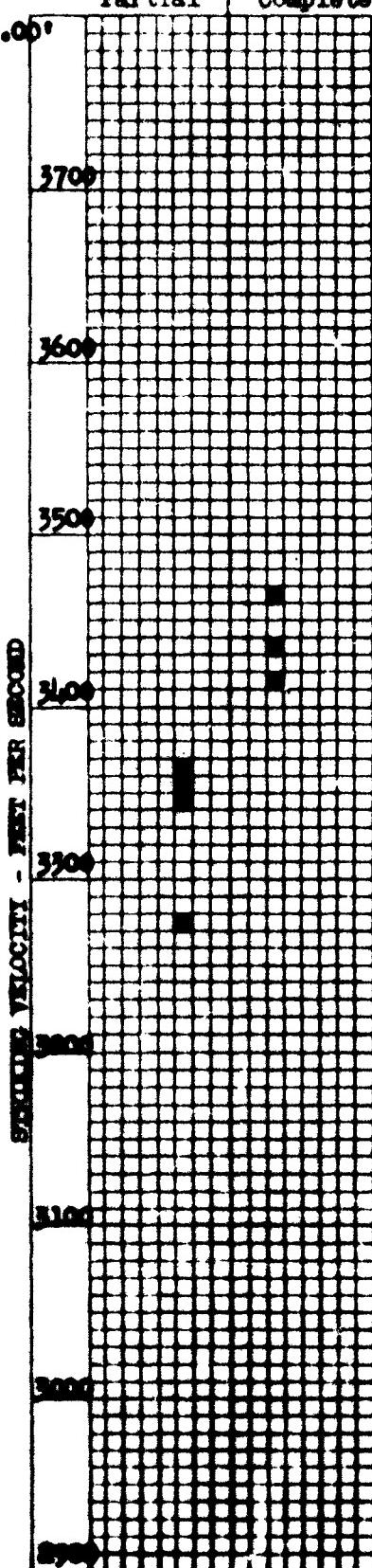
Projectile: cal .30 Ball M2
 Gun to 1st Screen: 60.65' 21.65'
 1st Screen to 2d Screen: 19.57' 15.00'
 2d Screen to Plate 102.07' 18.40'
 Obliquity: 0°
 Powder: 21664
 Gun No.: W4747

DATE: 5 April 1959

Partial Complete

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	70	3873	PP(P)				
2	70	Lost	PP(P)				
New Plate No. 16289-40, Size 1.497" x 18" x 36"							
3	70	3929	PP(P)				
4	70	3367	PP(P)				
5	70	3344	PP(P)				
6	70	3423	GP(P)				
7	70	Lost	GP(P)				
8	70	Lost	Mar.				
9	70	Lost	GP(P)				
10	71	Lost	GP(P)				
11	71	3468	GP(P)				
12	71	Lost	GP(P)				
13	71	3436	GP(P)				
 OV50 Ballistic Limit (Protection)							
High Partial Penetration							
Low Complete Penetration							
Speed							
 COMPLETED BY: [Signature]							
MODIFIED HANDLING AUTHORIZED				MODIFIED HANDLING AUTHORIZED			

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CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

ROUND-BY-ROUND DATA

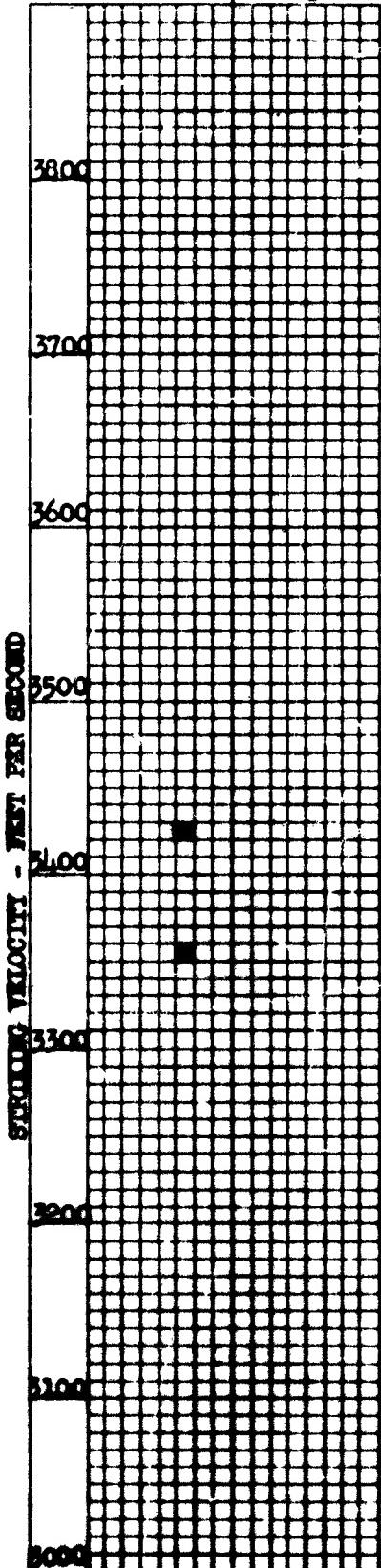
FIRING RECORD NO.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: 1.497" x 16" x 36"
~~Thickness~~ Plate No.
~~Specimen No.~~ H6288-1A
~~Manufactured by~~

Projectile: Cal .30 Ball M2
Gun to 1st Screen: 21.65'
1st Screen to 2d Screen: 15.00'
2d Screen to Plate 10.40'
Obliquity: 30°
Powder: 24664
Gun No.: 14747

DATE: 8 April 1959

Partial | Complete



~~CONFIDENTIAL~~
MODIFIED HANDLING AUTHORIZED

B-28

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

ROUND-BY-ROUND DATA

FIRING RECORD NO.

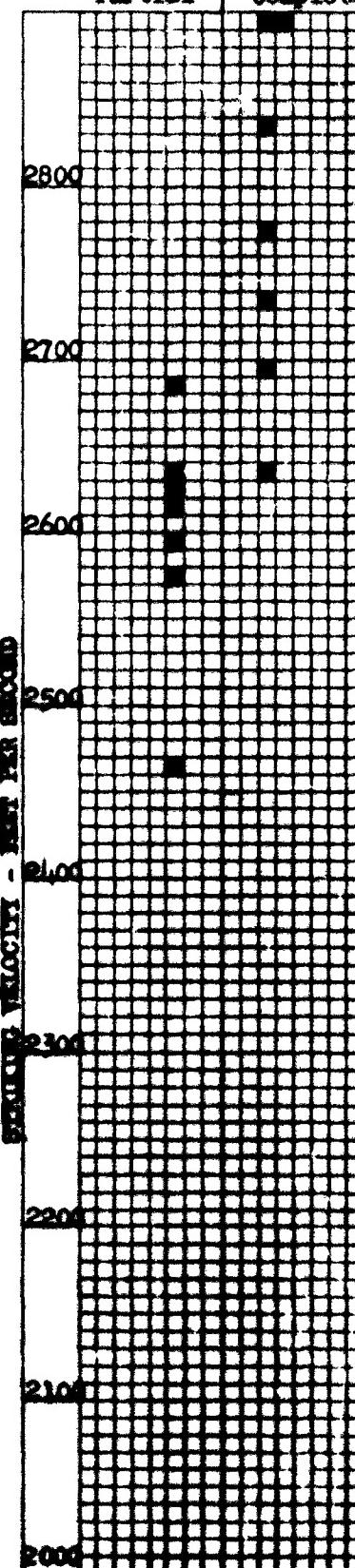
Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: 1.497" x 18" x 36"
Thickness Plate No.
1.000000 H6289-4C

Projectile: Cal .30 AP M2
 Gun to 1st Screen: 60.65'
 1st Screen to 2d Screen: 49.57'
 2d Screen to Plate 182.07'
 Obliquity: 30°
 Powder: 24664.
 Gun No.: 44747

DATE: 3 April 1959

Partial , Complete

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	70	Lost	Discr.				
2	70	3175	CP(P)				
3	66	3000	CP(P)				
4	62	2839	CP(P)				
5	56	2462	PP(P)				
6	59	2591	PP(P)				
7	60	2732*	CP(P)				
8	59	Lost	PP(P)				
9	59	2634*	PP(P)				
10	60	2650	Discr.				
11	60	2573	PP(P)				
12	60	2615	PP(P)				
13	63	2776	CP(P)				
14	60	2638*	CP(P)				
15	60	2644*	PP(P)				
16	60	2682*	PP(P)				
17	60	2693*	CP(P)				
M750 Ballistic Limit (Protection) = 2668 fpm							
High Partial Penetration = 2692 fpm							
Low Complete Penetration = 2638 fpm							
Stressed = 109 fpm							



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MODIFIED HANDLING AUTHORIZED

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

ROUNDBY+ROUND DATA

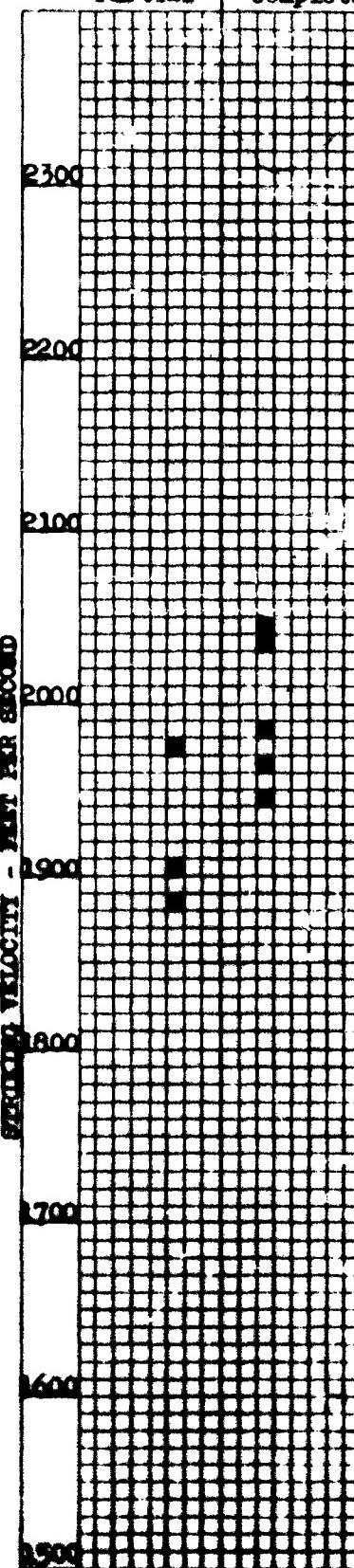
FIRING RECORD

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: 1.497" x 18" x 36"
Thickness Plate No.
Specimen No.: H6289-4C
Method of Test:

Projectile: Cal .50 Ball M2
 Gun to 1st Screen: 60.68'
 1st Screen to 2d Screen: 19.71'
 2d Screen to Plate 183.24'
 Obliquity: 30°
 Powder: 35683
 Gun No.: 22

DATE: 6 April 1959

Partial Complete



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~~MODIFIED BOUNDING UNAUTHORIZED~~

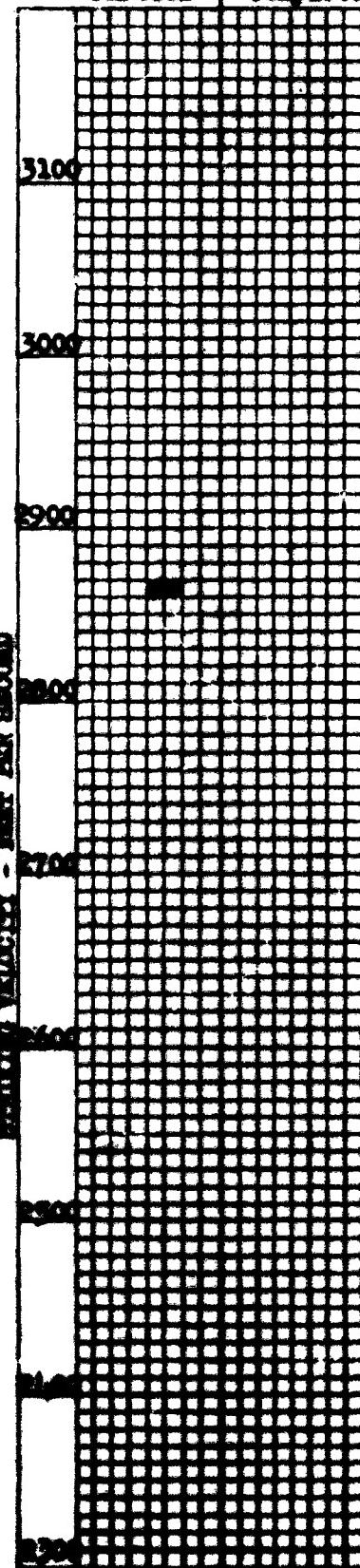
FIRING RECORD NO.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: 14.57" x 18" x 36"
Thickness Plate No.
Manufacturing No. 56288-4A
Manufactured

Projectile: Cal .50 Ball M2
 Gun to 1st Screen: 60.68°
 1st Screen to 2d Screen: 49.71°
 2d Screen to Plate 187.84°
 Obliquity: 60°
 Powder: 35683
 Gun No.: 22

DATE: 6 April 1999

Partial | Complete



~~CONFIDENTIAL~~
~~MODIFIED HANDLING AUTHORIZED~~

CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

1986 (3c) Rev
2 Dec. 2

~~MODIFIED~~ ^{about BY ROUND DATA}

Viking Record No.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: 1.57" x 18" x 36"
ZERKEL Plate No.
Submitted by: N6289-4C
Manufactured

Projectile: Cal .50 AP M2
 Gun to 1st Screen: 60.68°
 1st Screen to 2d Screen: 49.71°
 2d Screen to Plate 183.24°
 Obliquity: 30°
 Powder: 35683
 Gun No.: 22

DATE: 6 April 1959

Partial | Complete

Rd No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	125	1950	CP(P)				
2	135	1977	CP(P)				
3	125	1872	PP(P)				
4	130	1932	CP(P)				
5	125	1857	PP(P)				
6	128	1887	Distr.				
7	128	1897	PP(P)				
8	132	1948	Distr.				
9	132	1940	Distr.				
10	132	1954	Distr.)				
11	132	1953	CP(P)				
SVD Ballistic Limit (Protection)				1915 fm			
Full Partial Penetration				1897 fm			
Low Complete Penetration				1932 fm			
Front				1950 fm			

0.750 Ballistic Limit (Protection)	1915 fpm
High Partial Penetration	1897 fpm
Low Complete Penetration	1938 fpm
Surround	1939 fpm

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CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

00000-1303 (Rev.)

~~ROUND TRIP ROUND DATA~~
~~MODIFIED HANDLING AUTHORIZED~~

Material: Aluminum
Submitted by: Frankford Ars.
Type of Test: Development
Size: 1.497" x 18" x 36"
Elevation Pl. No.
Serial Number: B6288-4A
Manufactured:

Projectile: Cal .50 AP, M2
 Gun to 1st Screen: 60.68° 10.03'
 1st Screen to 2d Screen: 49.71° 10.03'
 2d Screen to Plate 157.24° 15.70'
 Obliquity: 60°
 Powder: 35683
 Gun No.: 1 28

FIRING RECORD NO.

DATE: 6 April 1959
10 April 1959

3200
3100
3000
2900
2800
2700
2600
2500

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CABBG 13k 1 Page
2 Dec 42

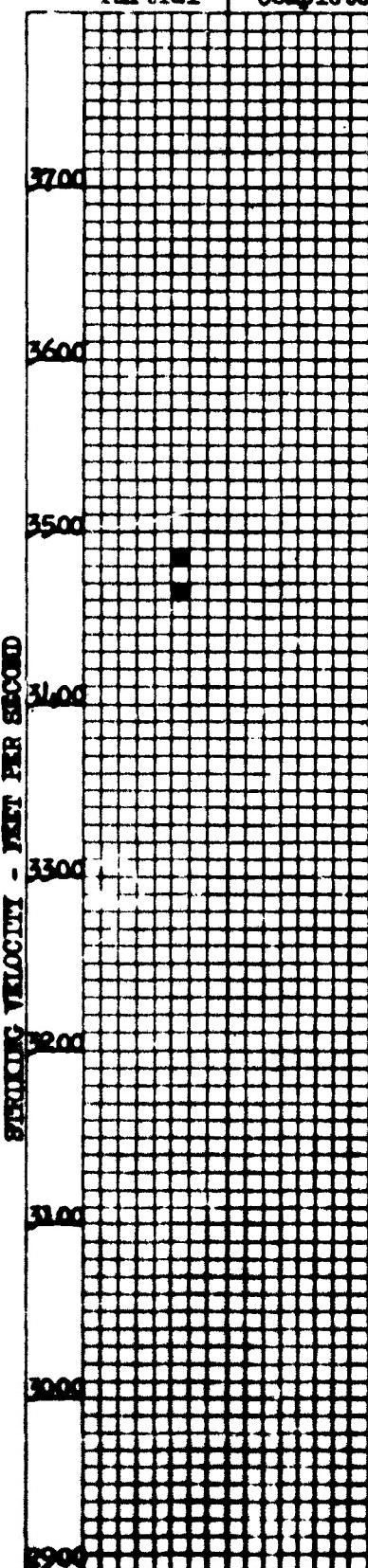
~~MODIFIED BY ROUND DATA~~ → AUTHORIZED

FIRING RECORD NO.

DATE: 9 April 1999

Material: Aluminum
Submitted by: Frankford Ars.
Type of Test: Development
Size: 1.767" x 18" x 36"
~~Specimen~~ Pl. No.
~~Specimen~~ 734-871 (2)
~~Specimen~~

Projectile: Obj .30 Ball, M2
 Gun to 1st Screen: 11.53°
 1st Screen to 2d Screen: 30.00°
 2d Screen to Plate 9.05°
 Obliquity: 0°
 Powder: 21.664
 Gun No.: W747



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ROUND-BY-ROUND DATA

MODIFIED HANDLING AUTHORIZED

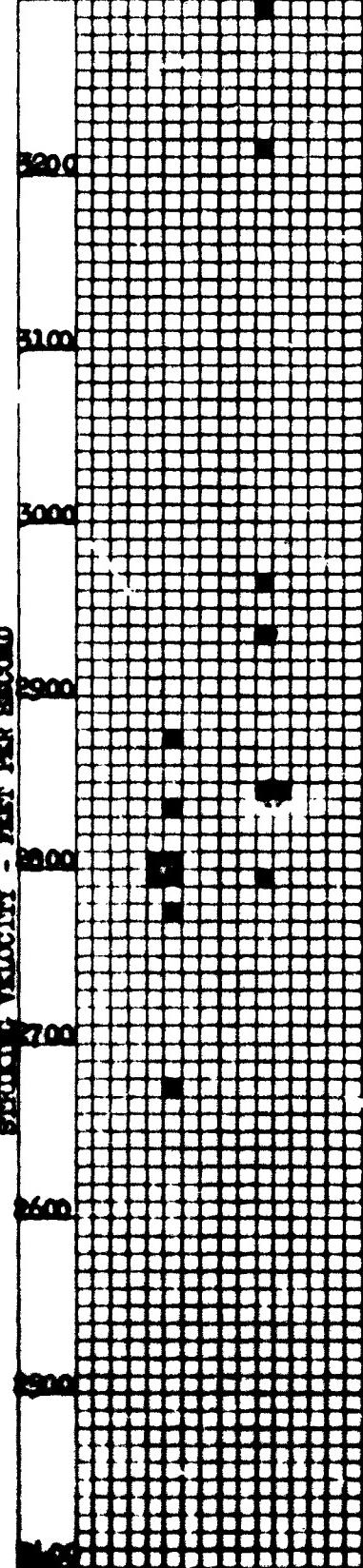
FIRING RECORD NO.

Material: Aluminum
 Submitted by: Frankford Ars.
 Type of Test: Development
 Size: 1.767" x 18" x 36"
 Remarks Pl. No.
 Test Identification: 734-871(2)
 Modification Record

Projectile: Cal .50 AP, M2
 Gun to 1st Screen: 11.53'
 1st Screen to 2d Screen: 10.00'
 2d Screen to Plate 10.45'
 Obliquity: 30°
 Powder: 24664
 Gun No.: 44747

DATE: 9 April 1959

Partial Complete



Pt. No.	Charge	Velocity	Result	Rd No.	Charge	Velocity	Result
1	70	3333	CP(P)	17	62	2968	CP(P)
2	66	3214	CP(P)	18	61	2933	Dia.
3	60	2798	CP(P)	19	62	2933	CP(P)
4	58	2775	PP(P)	20	61	2919	CP(P)
5	60	2817	CP(P)				
6	58	2678	PP(P)				
7	59	Lost	Dia.				
8	59	Lost	PP(P)				
9	59	2799	PP(P)				
10	60	2830	PP(P)				
11	60	2806	PP(P)				
12	61	2806	PP(P)				
13	62	2799	PP(P)				
14	62	Lost	Dia.				
15	62	Lost	CP(P)				
16	60	2816	PP(P)				

.50 Ballistic Limit (Protection) = 2834 f/s
 High Partial Penetration = 2933 f/s

Low Complete Penetration Speed = 2798 f/s
 Speed = 76 f/s

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CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

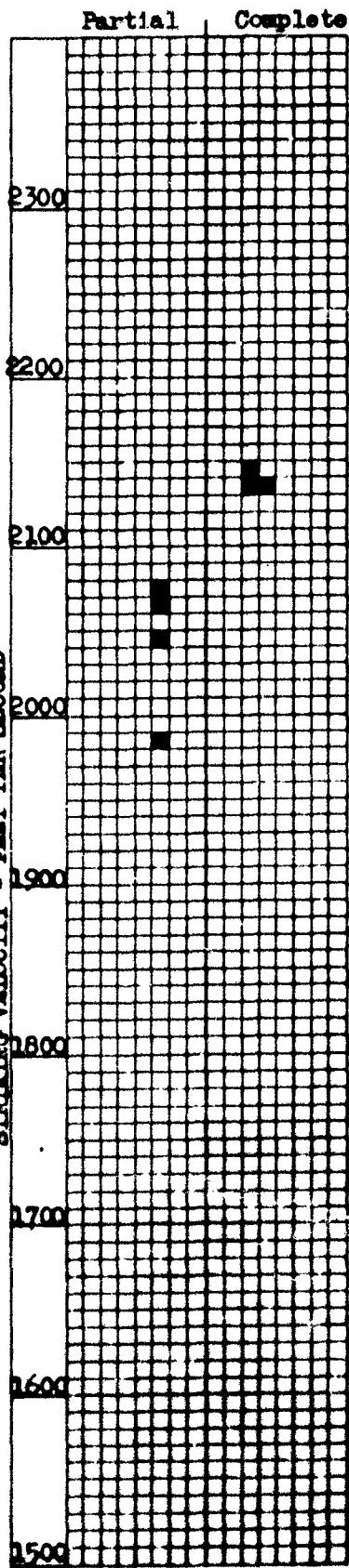
MODIFIED HANDLING AUTHORIZED

FIRING RECORD NO.

DATE: 7 April 1959

Material: Aluminum
 Submitted by: Frankford
 Type of Test: Development
 Size: 1.767" x 18" x .36"
 Plate No.
 Test No.: 734-871-2
 Mfg. No.: 22

Projectile: Cal .50 Ball #2
 Gun to 1st Screen: 60.63'
 1st Screen to 2d Screen: 49.71'
 2d Screen to Plate 183.29'
 Obliquity: 30°
 Powder: 35683
 Gun No.: 22



*V50 Ballistic Limit (Protection) = 2103 fps
 High Partial Penetration = 2079 fps
 Low Complete Penetration = 2136 fps
 Spread = 101 fps

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CONFIDENTIAL--MODIFIED HANDLING AUTHORIZED

MODIFIED ROUND METER READINGS AUTHORIZED

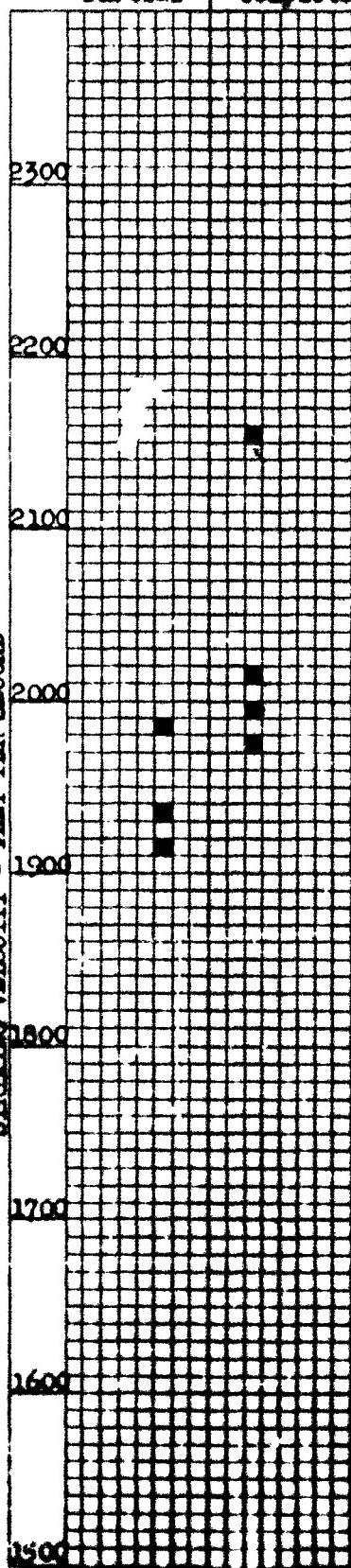
FIRING RECORD NO.

Material: Aluminum
Submitted by: Frankford
Type of Test: Development
Size: 1.767" x 18" x 36"
Thickness Plate No.
Tested Strength 734-871(2)
Method of Test

Projectile: Cal .50 AP M2
 Gun to 1st Screen: 60.68'
 1st Screen to 2d Screen: 49.71'
 2d Screen to Plate 183.24'
 Obliquity: 30°
 Powder: 35683
 Gun No.: 22

DATE: 6 April 1959

Partial Complete



•V50 Ballistic Limit (Protection)	=	1969 fps
High Partial Penetration	=	1981 fps
Low Complete Penetration	=	1974 fps
Spread	=	101 fps

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~~MODIFIED HANDLING AUTHORIZED~~